The Role of Regional Ponds In Fairfax County's Watershed Management

Prepared by

Environmental Coordinating Committee
Regional Pond Subcommittee
Fairfax County, Virginia

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TABLE OF CONTENTS

O. Regional vs. On-Site Facilities
P. Regional Pond Interim Decision Matrix and Worksheets

Q. Regional Stormwater Management: A Summary of Policies in Virginia and Maryland
R. Stormwater Management Facility Comparison Chart

Related Materials and Policy Statements

S. January 23, 1989 Board Action Item - Report on Review of Safety and Liability of Stormwater Detention Ponds containing:
- Nine recommendations
- Approval of Regional Stormwater Management Plan as first recommendation

T. August 5, 1991 Board Information Item - Status Report on Implementation of Safety and Liability Recommendation for Stormwater Management Ponds with the Regional Stormwater Management Implementation Procedures
U. August 2, 1993 Board Action Item - Implementation of the Forested Wetlands Committee Recommendations to minimize Disturbance of Wetlands During Implementation of Regional Stormwater Management Ponds with the Forested Wetland Committee Report
V. February 26, 1996 Board Information Item - Notification Procedures for Roadway Capital Construction Projects Involving the Repair and Replacement of Existing Facilities
W. December 1998, Fairfax County Park Authority Policy Manual – Policy 304, Regional Storm Water Management
X. 2000 Policy Plan - Fairfax County Comprehensive Plan, Environment (http://www.fairfaxcounty.gov/dpz/comprehensive_plan/main.htm)
Y. October 2, 2001, Letter to Industry #01-11 - Revised Procedures for Requests to Use Innovative Best Management Practices (http://www.fairfaxcounty.gov/gov/DPWES/publications/LTI/01-11.pdf)
Z. May 14, 2002, Letter to Industry #02-06 - Innovative BMPs – Enhanced Extended Detention Dry Ponds Now Acceptable for Public Maintenance in Residential Areas and on Governmental Sites (http://www.fairfaxcounty.gov/gov/DPWES/publications/LTI/02-06.pdf)
AA. August 21, 2002, Memorandum - County Practices Related to Stormwater Facilities and Mosquito Control
BB. 2003 Fairfax County Regional Pond Program Status

LIST OF FIGURES

EXECUTIVE SUMMARY

Background

On January 28, 2002, the Board of Supervisors directed staff to form a multi-agency committee to develop a unified position on the use of regional ponds as well as other alternative types of stormwater controls as watershed management tools. In addition, the Board directed staff to review the issues outlined in an Environmental Quality Advisory Council resolution, dated February 13, 2002, which recommended a review and revision of the County's Regional Stormwater Management Plan. This Plan, adopted in 1989, provided for a system of regional stormwater management facilities within the developing watersheds of the County.

The direction from the Board came at a time when several related factors were converging: a concern over the condition of streams and stream valleys in Fairfax County; an increased citizen interest in stormwater management; the development of new stormwater management techniques and best management practices; the publication of the County's Stream Protection Strategy Study; the Infill and Residential Development Study, the stream re-mapping project; consideration of revisions to the Chesapeake Bay Preservation Ordinance; and development of watershed management plans called for in the multi-state Chesapeake Bay 2000 Agreement.

The Environmental Coordinating Committee (ECC) created a Regional Pond Subcommittee composed of fifteen members that included the Environmental Coordinator and representatives from the Department of Public Works and Environmental Services, Department of Planning and Zoning, Fairfax County Park Authority, Northern Virginia Soil and Water Conservation District, and the Environmental Quality Advisory Council. The Subcommittee's charter, endorsed by the ECC on April 15, 2002, provided that the Subcommittee, in a deliberate and comprehensive way, determine whether modifications to current practices, policies and regulations would be beneficial, and make recommendations.

Process

The Subcommittee began by identifying and defining the issues to be addressed to develop a greater understanding of the relationships between and among: watershed management; regional ponds; other stormwater management practices; current County policies and practices regarding stream protection; federal, state and County regulations and initiatives; the experience of other jurisdictions; and maintenance and fiscal considerations. The Subcommittee studied both facts and perceptions about the positive and negative aspects of regional ponds. A comprehensive list of issues was organized into the following eleven categories and became the basis for further research and eventually the *Findings Concerning Regional Ponds* section of this report:

- Ecology
- Economics
- Local, State, and Federal Permits, Regulations and Policies
- Hydrology and Design
- Land Use and Watershed Management
- Parks and Recreation
- Health and Safety
- Aesthetics
- Construction Planning and Phasing
- Public Participation, Outreach and Support
- Stormwater Management in Other Jurisdictions

The Subcommittee then considered what would be *An Ideal Stormwater Program* and organized the goals and elements of such a program under the first ten categories. At this point, the Subcommittee met with a planning group of representatives from business, industry, homeowner associations, environmental organizations, and interested citizens to verify it was on the right track and to help plan for a larger meeting of stakeholders. A public meeting was held on November 19, 2002, where interested stakeholders, representing a variety of perspectives, were invited to review and comment on the *Findings* and *Ideal* sections of the report and to offer suggestions and recommendations. The Subcommittee also invited a group of peers to review and comment on the preliminary report. Based on its research and findings, and input from stakeholders and peers, the Subcommittee then formulated *61 Recommendations* for approaching the goals of an ideal program and for improving Fairfax County's stormwater management program, within the context of current land-use and development in the County. It also developed a *Unified Position* on the role of regional ponds. On March 3, 2003, the ECC endorsed forwarding the report of the Subcommittee, *The Role of Regional Ponds in Fairfax County's Watershed Management,* to the Board of Supervisors' Development Process Committee, with the understanding that there would be several public outreach efforts and the development of an implementation plan.

Conclusions

The Subcommittee's *Unified Position on Regional Ponds and Other Watershed Management Tools* is that regional ponds should not be considered the preferred alternative, but just one of many tools considered for stormwater management. The Subcommittee identified 61 *Recommendations for Improvements to Fairfax County's Stormwater Management Program*, made within the ten subject areas that were studied, that support this position and outline ways to improve Fairfax County's stormwater management program.

The *Recommendations* are encompassed in the following broad concepts:

- Ensuring that stormwater management approaches support the protection and restoration of the ecological integrity of stream valley ecosystems, including groundwater recharge.
- Revising policies, regulations and procedures to allow and to encourage the best solutions, including new techniques and innovative practices, as well as aesthetically pleasing designs.
- Adopting flexible policies that conform to watershed management plans, taking into consideration cumulative impacts, timely installation, retrofitting earlier development, and considering all available tools.
- Stakeholder participation, at the beginning and during the stormwater and watershed planning processes, and as a part of community stewardship initiatives.
- Adequate and timely funding.

Priorities for implementing the *Recommendations* have not been developed. While the *Recommendations* include major concepts and provide general direction, the priorities would be established as resources are considered and an implementation plan is prepared.

Although the watershed management plans are not complete and thus remedial measures are still unknown; an estimate for installing any proposed measures is not available. The *Recommendations* and the *Unified Position* are consistent with the Capital Improvement Program, both for the near term (next five years) and the long term (beyond five years).

The Subcommittee highlights the following key elements of the *Recommendations*:

- Revise the current County policy regarding regional ponds to reflect these recommendations, in particular designating regional ponds as just one of many stormwater management tools.
- Develop recommendations for stormwater management practices as part of the watershed planning process.
- Until watershed plans are completed, use an interim decision matrix as the guidance for determining whether regional ponds are appropriate on a case-by-case basis. Initiate a pilot project to validate this interim matrix.
- Develop a second matrix for use in preparing watershed management plans. This matrix should provide options when considering and evaluating stormwater management alternatives.
- Carefully evaluate the impacts on stormwater management systems, including streams, when making land use decisions.
- In watersheds where regional facilities currently are planned, require temporary on-site facilities until regional ponds or equivalent stormwater practices are implemented.
- Establish conditions on stormwater detention (water quantity) and BMP (water quality) waivers to ensure that measures are provided to offset, to the greatest extent practicable, the impacts of the waivers being granted.

- Ensure that waivers dealing with stormwater controls and floodplain management are granted only in concurrence with watershed management plans.
- Use alternatives to regional ponds where consistent with the watershed management plans. When regional ponds are warranted, use techniques to reduce the impacts of the pond.
- Allocate adequate resources to accomplish these recommendations.

Next Steps

It is recommended that an implementation plan be prepared for Board of Supervisors' action. This would occur concurrently with outreach efforts, including public meetings, to inform and engage interested stakeholders.

The Watershed Management Plans will help the County determine its priorities for future years.

I – Introduction and Background

A - Formation of the Regional Pond Subcommittee

On January 28, 2002, the Board of Supervisors directed staff to form a multi-agency committee to develop a unified position on the use of regional ponds, as well as alternative types of stormwater controls, as watershed management tools. In addition, on February 25, 2002, the Board directed staff to review the issues outlined in an Environmental Quality Advisory Council (EQAC) resolution regarding regional stormwater management. The resolution raised issues concerning: the availability of advanced techniques for the management of stormwater; the review and revision of the County's Regional Stormwater Management Plan adopted in 1989 in the context of these new tools, the County's Stream Protection Strategy, the County's Watershed Management Plans, and the Chesapeake Bay Preservation Act; the effects of waivers of stormwater detention and water quality requirements on stream quality; funding of regional ponds; analysis of the impact of regional ponds on stream ecosystems and morphology; and amendment to the Policy Plan portion of the Comprehensive Plan.

In response to the Board's requests, the Fairfax County Environmental Coordinating Committee (a group of representatives from County agencies that share in the County's environmental mission) formed a "Regional Pond Subcommittee," consisting of the Environmental Coordinator and members from the Department of Public Works and Environmental Services (DPWES), the Fairfax County Park Authority (FCPA), the Department of Planning and Zoning (DPZ), the Northern Virginia Soil and Water Conservation District (NVSWCD), and the Environmental Quality Advisory Council (EQAC), to consider the motion and report back with recommendations.

B - Types of Stormwater Management Ponds

The stormwater management ponds mentioned in this report may be categorized as follows:

- Dry ponds, or detention basins - store stormwater runoff for a specified period and discharge it at a slower rate until the pond is dry. Dry ponds include:
    - Detention only ponds - designed to control only flood flows or water quantity
    - Extended detention ponds - designed to control flood flows in addition to improving water quality by allowing stormwater pollutants to settle out
    - Enhanced detention ponds - designed as extended detention but include additional water quality improvement features such as wetlands or a marsh bottom
- Wet ponds - include a permanent impoundment, or pool of water, that normally stays wet even between rainfalls.

Dry ponds and wet ponds can be either:

- Regional ponds – serve an area generally greater than 100 acres, frequently located along main stem of streams

- On-site ponds – serve an area generally less than 100 acres, frequently located in lower areas of developing sites.

C - Regional Stormwater Management Ponds in Fairfax County

In the mid-1980's, Fairfax County commissioned a study to examine approximately 100 square miles of the developing western portion of the County for potential regional stormwater management pond sites. The study was initiated to address water quality issues on a countywide basis. These "regional ponds" could control larger watersheds (100 to 300 acres) and reduce the maintenance burden to the County by reducing the total number of ponds that would be required to be maintained if they were constructed on individual developments. Regional ponds were viewed as a cost-effective means of controlling erosion and flooding that resulted from increased storm flows associated with development.

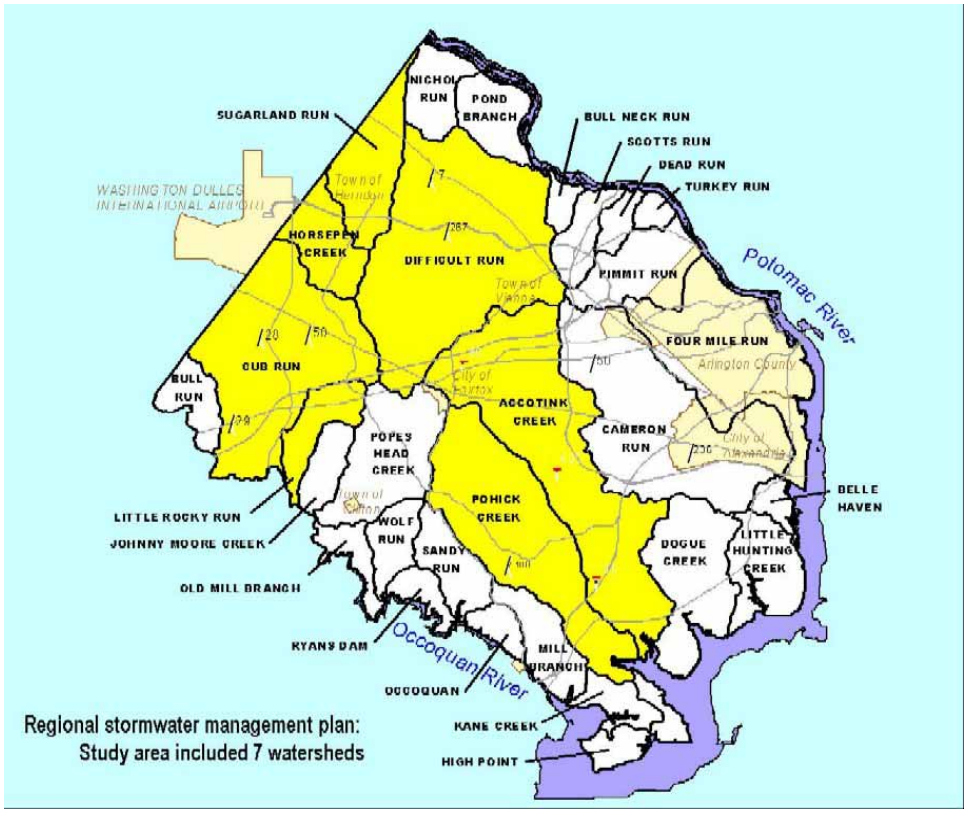

Figure 1. Fairfax County Regional Pond Study Areas

On January 23, 1989, the Board of Supervisors adopted the Regional Stormwater Management Plan for managing stormwater countywide. The original plan identified 134 sites, primarily in the western part of the County, for building regional ponds that would control stormwater runoff to reduce peak flow rates, prevent erosion and flooding, and improve water quality. The County planned to phase-in construction of these ponds as stormwater runoff increased in developing watersheds. The Regional Stormwater Management Plan was conceived as a pilot project to be applied Countywide if deemed successful. Currently, approximately 150 regional ponds are included in the plan with 46 sites constructed and operational. In addition to regional stormwater ponds, other stormwater management practices were continued or established in order to support water quality efforts in the region and the County's own policies. Developments continue to be approved and constructed under this plan.

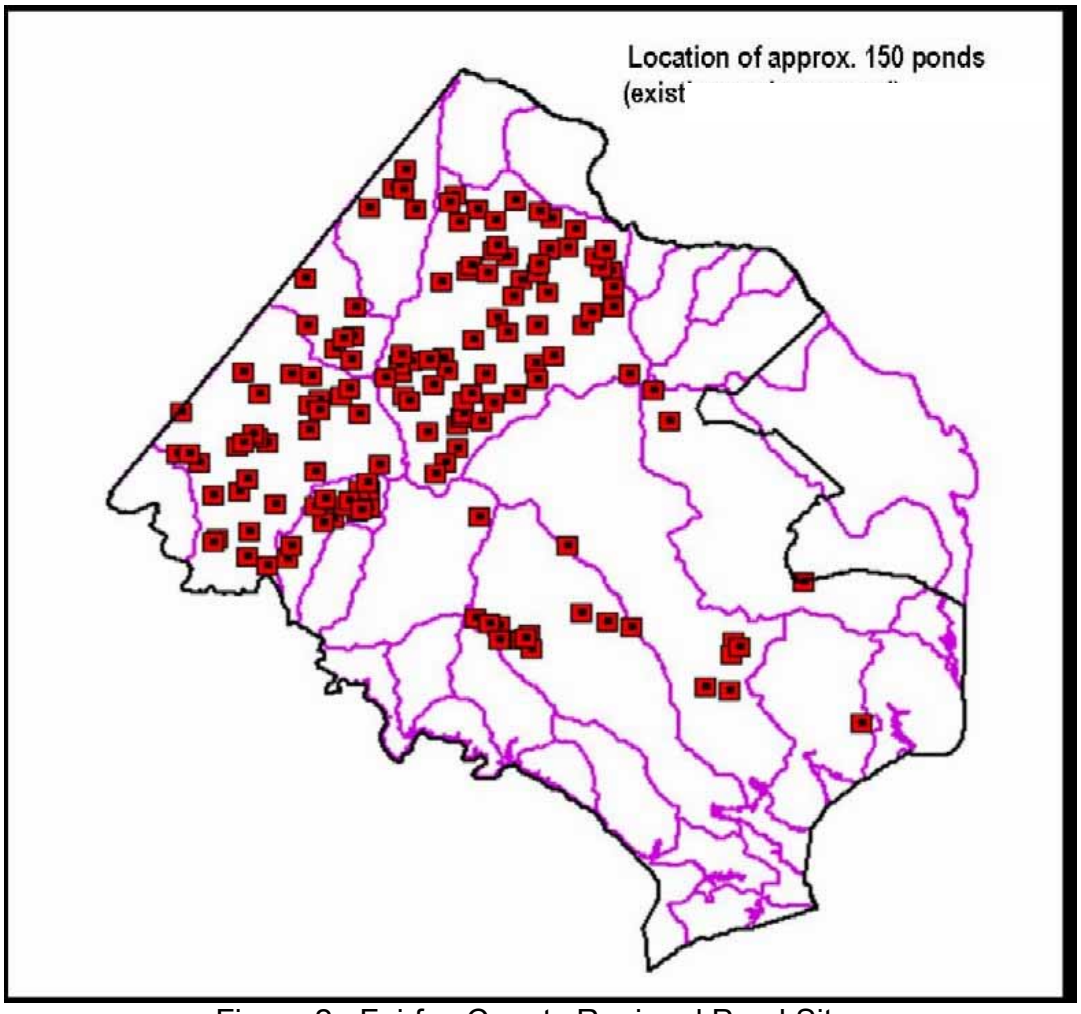

Figure 2. Fairfax County Regional Pond Sites

On August 2, 1993, the Board of Supervisors concurred in staff's recommendation and adopted the *Policies and Procedures for Establishing Methods to Protect Wetlands during Implementation of Regional Stormwater Management Ponds.* The Forested Wetlands Committee, an Ad Hoc committee established by the Board of Supervisors,

prepared this document. Some of the recommendations contained in the document were dependent upon future funding.

Fairfax County continued to witness an evolution of new federal and state guidelines and regulations regarding stormwater controls and best management practices (BMPs) to reduce not only erosion and flooding, but also nutrients and sediment from entering into the Chesapeake Bay. Under the County's Chesapeake Bay Preservation Ordinance, Resource Protection Areas (RPAs) were designated along streams throughout the County. All other areas were designated as Resource Management Areas. Because dry ponds designed solely to provide quantity controls (detention only dry ponds) do not filter nutrients and sediment adequately, retrofit efforts were undertaken during the mid-1990's to determine the feasibility of modifying existing stormwater control ponds to include nutrient and sediment controls to comply with the new discharge permit requirements under the County's Virginia Pollutant Discharge Elimination System (VPDES) permit.

In September 1998, the County launched a stream protection initiative. The Stream Protection Strategy (SPS) Baseline Study, published in January 2001, gave a temporal view of the condition of the County's streams using biological indicators such as fish and aquatic insects to determine the ecological integrity of the streams and their supportive environment. In October 2001, the County commenced its watershed planning initiative to develop watershed management plans for all watersheds over a 5-7 year period. As part of this effort, a stream physical assessment was initiated for each of the watersheds.

Since the adoption of the Regional Stormwater Management Plan, there have been advances in the way stormwater is managed, including managing stormwater as close to the source as practicable. These better site design and low-impact development methods use a combination of innovative techniques and practices to reduce, detain, retain and filter stormwater closer to the source. These practices can be implemented separately, incorporated as part of an overall stormwater management plan, or used to retrofit existing systems. In October, 2000, the Board of Supervisors approved an amendment to Fairfax County's Policy Plan (the Countywide policy element of the Comprehensive Plan) that established an explicit objective for the protection and restoration of the ecological integrity of streams and that encouraged the use of better site design and low-impact development practices.

D - Focus and Approach of the Subcommittee

The Regional Pond Subcommittee will provide recommendations to the Environmental Coordinating Committee regarding the use of regional ponds as well as other innovative and non-structural techniques as part of watershed management. The focus of the effort is to determine in a deliberate and comprehensive way whether modifications to current practices, policies and regulations would be beneficial.

In order to understand the problem, the Subcommittee began by distinguishing between fact and perception about the regional pond program. The Subcommittee first identified a comprehensive list of issues and divided them into the following categories for consideration.

A. Ecology
B. Economics
C. Local, State, and Federal Permits, Regulations and Policies
D. Hydrology and Design
E. Land Use and Watershed Management
F. Parks and Recreation
G. Health and Safety
H. Aesthetics
I. Construction Planning and Phasing
J. Public Participation, Outreach and Support
K. Stormwater Management Programs in Other Jurisdictions

The Subcommittee then focused on what is perceived as being right about regional ponds and what is wrong with regional ponds. This information was organized into the categories listed above and became the basis for further research and eventually the *Findings* section of the report. The subcommittee then considered what would be an *Ideal* stormwater program, and finally developed *Recommendations* for approaching that goal and improving the County's stormwater management program, given the reality of current land-use and development in the County.

II – Findings Concerning Regional Ponds

A – Ecology

In the October, 2000 amendment to the Policy Plan, an Objective was added to the Plan that states: "Protect and restore the ecological integrity of streams in Fairfax County." The County's Stream Protection Strategy Baseline Study (January 2001) provided a snapshot of the ecological health of the County's streams. Continued assessments of stream health, along with comprehensive watershed-based strategies to protect and improve stream health, will be integral components of the County's watershed planning initiatives (Watershed Management Plans). The County is dedicated to the protection and restoration of ecological health to its streams and has devoted considerable resources toward this end. Therefore, ecological considerations must be a central component of this review of the County's regional pond program. In the Subcommittee's view, ecological issues can be considered upstream of regional pond sites, at regional pond sites, and downstream of regional pond sites.

Regional pond sites obviously do not directly affect upstream areas. However, the County's current policy and practice related to stormwater management for development projects located upstream of regional pond sites can have significant effects on the ecological conditions of streams above these sites. Two key aspects of stormwater management consist of water quantity (volume and velocity) control through detention and water quality control through BMPs. The regional pond program concept consists of achieving water quantity control by implementing regional ponds in lieu of a greater number of smaller, on-site ponds. The regional ponds also provide for water quality control. Current policy permits development within a regional pond watershed prior to the implementation of the pond. Under this policy, developers of properties upstream of regional pond sites may receive a waiver of the requirement for on-site detention in certain circumstances. Such situations may include developments that would result in minimal increase in peak runoff or in a relatively small increase in impervious area or development of small lots with little room for an onsite pond. Cost versus benefit considerations with respect to the County's cost to maintain these facilities also are a factor in reviewing detention waiver requests. Whether or not a detention waiver is granted, adequacy of outfall, i.e., conveyance of stormwater into a natural watercourse or drainage facility without adverse impact, must be demonstrated.

When a site is not required to provide onsite stormwater detention, runoff is discharged uncontrolled and the resulting increases in volumes and velocities of stormwater runoff may cause increased channel scouring between the developing sites and the regional pond sites (Schueler and Holland, the Practice of Watershed Protection, Article 79, 2000). Reliance on regional ponds downstream of these developing sites also may inhibit possible innovation in design of these developments, as there is no impetus for a developer to pursue site design and/or low-impact development approaches that would serve to reduce stormwater runoff volumes. As to water quality control, under the provisions of Chapter 118 of the County Code, Chesapeake Bay Preservation

Ordinance, sites upstream of planned regional pond sites located outside of the Occoquan Watershed are exempt from the requirement to provide water quality controls if pro rata share is paid toward a regional pond, whether planned or constructed.

At regional pond sites, stream valley habitat may be destroyed in order to provide for the construction of pond embankments, storage areas, control structures, and maintenance access roads. A certain extent of such impacts can occur even in conjunction with the construction of embankment-only facilities (facilities that are designed such that vegetative cover in areas upstream of the embankment and control structures is retained). Further, regional ponds have been sited along the main stems of streams rather than off-stream, based on the County's 1989 regional pond siting criteria. The result of such siting can be the fragmentation of wildlife corridors and the creation of impediments to the upstream migration of fish (Schueler and Holland, the Practice of Watershed Protection, Article 79, 2000). Because wetland areas often are located in stream valleys, the potential for losses of wetlands due to pond construction is also high, albeit less for embankment-only facilities than for more traditional pond designs. Depending on pond design, thermal impacts (both from the collection of heated stormwater runoff and the direct heating of water in the pond by sunlight) may affect aquatic life within wet ponds, particularly where such ponds are relatively shallow (Schueler and Holland, 2000).

Regional Pond Access Road Analysis

Based on Geographic Information System (GIS) analysis of 42 existing regional ponds, the average access road length is estimated to be 400 feet. The shortest road length is 37 feet and the longest is 1366 feet. By applying a typical access road disturbance width of 20 feet for a 12-foot wide road, the typical disturbed area for the County's regional ponds is estimated to be 8000 square feet or 0.2 acres per regional pond.

While regional ponds alter pre-existing habitat conditions (both during and after construction), it has been suggested that regional ponds can improve biodiversity and enhance habitat. These claims must be examined carefully. Little information is available about how fast wildlife and vegetation can recover and diversify after the construction of in-stream stormwater management ponds. Construction of in-stream regional ponds removes ground cover and increases upstream impoundment. A few studies indicate that new wet regional ponds will develop biodiversity gradually by attracting new plant, birds, fish, and amphibian specie (Bishop et al, 2000). The same studies shows that in-stream dry ponds, when not mowed, gradually self-seed into wetlands and voluntarily develop new vegetation and wildlife habitat. However, these studies have reported low to medium richness in species utilizing the ponds. A few other studies have tried to develop an inventory of the vegetation and wildlife utilizing in-stream ponds (Bishop, et al, 2000). However, the Subcommittee is not aware of any study that compares pre- and post-construction plant and wildlife inventories. Further, little information is available about the cumulative impact of scattered on-site stormwater management ponds on the stream ecology.

Despite these ambiguities, the design of traditional in-stream stormwater management ponds certainly can be modified such that a greater variety of species will be present within the pond basin. For example, by turning a dry regional pond into a constructed stormwater management wetland or by adding one or more aquatic platforms (shallow benches on which aquatic vegetation can be planted) to the pond, there may be an increased biodiversity within the pond. Such design modifications may or may not necessitate an increase in the pond's footprint. Fairfax County presently is modifying the designs of many dry stormwater management ponds to increase biodiversity, and numerous design guidelines are available (e.g. Schueler and Holland, 2000, and Virginia Stormwater Management Handbook, Vols. I & II, First Edition, 1999).

In all areas below development sites downstream of regional pond sites, significant streambank and streambed erosion can occur during the periods of time prior to regional pond construction. As noted earlier, development upstream of regional pond sites, in areas outside of the Occoquan Watershed, is allowed to proceed without on-site stormwater management controls prior to regional pond construction. Due to a number of factors (e.g., economics, funding, citizen opposition), the construction of the regional ponds can be delayed for years, and their construction can be pre-empted or their size reduced so that they are only marginally effective. As a result, downstream impacts can persist for relatively long periods of time. The sediment that is carried away from these eroding areas in turn can result in reduced biodiversity in areas further downstream, where sediment deposition can alter the natural morphology (form and structure) of streams. Ultimately, increased sediment generation can add to sediment concentrations in the Potomac River and Chesapeake Bay.

Even when constructed, regional ponds are not designed to reduce runoff volumes. Indeed, by extending the duration of erosive flows, the current designs of some regional ponds potentially could increase the duration and extent of streambank and streambed erosion in downstream areas by extending the time of bankfull discharges. While this issue is not unique to regional detention ponds, it does highlight a concern about regional pond design. Further, depending on pond design, regional ponds, whether wet or dry, may cause warmer water to be discharged into downstream areas than would have occurred absent these ponds, with a related reduction in biodiversity in downstream areas (Schueler and Holland, the Practice of Watershed Protection, Article 79, 2000).

Regional ponds are more efficient in removing pollutants compared with on-site stormwater management ponds. However, the overall impact of regional ponds on downstream water quality is complex. Fairfax County's Stream Protection Study (Fairfax County Stream Protection Strategy Baseline Study, January 2001) characterizes the in-stream habitat conditions downstream of several regional ponds in Fairfax County as being good to excellent, although no baseline data are available to compare present water quality with pre-development water quality. Release of deep waters from the permanent pools of deep-water ponds is one mechanism through which cooler water can be discharged from these ponds. However, because deeper water in

ponds tends to have higher concentrations of pollutants than water closer to the pond surface, the release of deep waters will allow more pollutants out of the permanent pool.

In summary, it is the view of the Subcommittee that broad generalizations related to ecological considerations of regional ponds cannot be made; this issue is a complex one that relates as much to policies regarding design aspects and upstream controls as it does to inherent impacts and ecological characteristics of regional ponds. There are numerous potential ecological impacts and opportunities associated with regional ponds, and no single statement about these impacts and opportunities applies to all cases.

B - Economics

Regional ponds have several economic implications with respect to capital and maintenance costs, land values, and environmental and land development costs. This section identifies some of the major issues related to the economics of regional ponds.

One of the objectives of the regional stormwater management plan has been to provide a cost-effective stormwater management system. The regional concept offers lower capital construction and maintenance costs compared to an on-site system of stormwater control facilities, primarily because fewer regional ponds are needed to control a watershed of similar size.

As far as construction costs are concerned, since there are fewer facilities, even though larger, total cost to provide runoff control is less because of economies of scale for a regional pond than for the equivalent control when using several on-site ponds. In the regional pond situation, the ponds are sited within stream valleys where a greater incremental storage volume is available or obtained without massive regrading. In an on-site pond system, the ponds generally are located in the lower areas of developing sites, and have to be “carved into” the topography because they do not have the opportunity to take advantage of natural waterways to provide the required storage. The on-site system takes much more hauling and trucking to remove soils to provide the needed storage volumes and to provide for the appropriate grades to permit gravity flow. In addition, the cumulative length of access road for on-site ponds exceeds that of the total length of an access road for a regional pond. Therefore, with the same costs per linear foot, the longer road lengths will cost more than shorter lengths.

Since the number of regional ponds is much smaller than the number of on-site detention ponds required to serve an equivalent watershed area, the overall maintenance costs of regional ponds will be less than costs for on-site detention ponds. This cost difference was an important consideration when the County’s regional pond program was developed. On a per-acre, controlled basis, it is Fairfax County’s experience that regional pond maintenance costs are approximately 1/6 of the maintenance costs of on-site detention ponds that are designed to control both water quality and quantity.

In residential areas, it is the County's policy to require private maintenance (homeowners association bears costs) of on-site wet ponds and County maintenance of regional wet ponds. Basically, it is less expensive for homeowners associations when a regional pond is in place. The maintenance costs should be the same between the two for the same level of service. The issue is just who pays for it.

On-site ponds, especially those located near or adjacent to residential lots, may contribute to reduced property values with few exceptions because of perceived safety and aesthetic issues that landowners may have, particularly in on-side dry detention pond cases. More land adjacent to residential lots is disrupted to construct a pond in the on-site situation, whereas regional ponds are located in stream valleys, further away from residential structures and do not disrupt as many neighbors.

Regional ponds (particularly wet regional ponds), when well designed, well located, and adequately maintained, may add a premium to adjacent lots when compared with similar lots located within the same development, but not adjacent to the pond site. For example, a survey conducted for the U.S. Environmental Protection Agency (EPA) in several counties nationwide indicated that a well-designed regional pond in Fairfax County adds about $10,000 to the value of a single-family home with a base value of $333,000 to $368,000. In this case, the increase in property value also applies to condominiums and commercial real estate. The survey also showed that the premium stays, and even increases, long after the property has been sold to the next owner, provided that the pond is maintained adequately. The increase in property value is directly related to pond size and presence of low-cost amenities such as fountains (pond aeration), footpaths, bike trails, gazebos, and attractive landscaping.

From a Countywide, programmatic perspective, the regional pond program has not been implemented in a uniform or methodical manner. No dedicated funding source was established to support the program at its inception. Therefore, funding has not been sufficient to provide for land acquisition, design, and construction of the planned regional ponds. Consequently, only approximately one-third of the currently planned 150 regional ponds have been constructed during the 12 to 13 years that the program has been in place. For the most part, regional ponds have been constructed as a result of negotiated commitments made with land developers during the land rezoning process. Most of these commitments provide for some reimbursement from Pro Rata Share Program fees which developers pay to fund off-site drainage improvements necessitated by the increased run-off from their developments. Typically, a developer will proffer to construct a regional pond that is planned for the area of the development. Under a negotiated agreement, the County reimburses the developer for capital costs exceeding normal responsibility for providing stormwater control for the development. The reimbursement funds come from existing Pro Rata Share funds or from the future collection of Pro Rata Share fees. This approach has been opportunistic and ad hoc, simply because there are not sufficient funds in the Pro Rata Share program or from a dedicated source to be proactive and or methodical in implementation. In addition, the collected Pro Rata Share funds are identified not only for regional ponds but also for

flood control projects, stream stabilization needs, and road crossing improvements which may have a higher priority in service to the community. Because regional ponds have not been top priority for allocation of Pro Rata Share funds, construction of the ponds has not kept pace with development of the watersheds. However, by policy, ponds do become a higher priority as opportunities arise to implement these controls during development of the watershed. This has the benefit of cost sharing the facilities with the development community, or those who will ultimately use them. The County has initiated some regional pond projects because enough Pro Rata Share funds have accumulated.

Estimate of Pro Rata Share Revenue Until Countywide "Build-out"

Based on the current pro rata share drainage improvement program, the estimated revenue that may be collected throughout the County until "build-out" occurs is between $41 million and $47 million. The $41 million value is based on build-out in 10 years. The $47 million value is based on build-out in 20 years. The pro rata share calculation method is defined in Section 6-0600 of the Public Facilities Manual. Based on a GIS analysis performed by Stormwater Planning Division staff, existing Countywide imperviousness is 15.7%. The same analysis estimates ultimate Countywide imperviousness to be 17.9% based on the current Comprehensive Plan.

This ad hoc implementation approach somewhat defeats the purpose of providing stormwater controls as it is desirable to implement the controls prior to or during land development of the watershed. Often several smaller developments in a particular regional pond watershed, which are not large enough to warrant
a large, front-end financial commitment such as construction of a regional pond, contribute funds without providing stormwater controls. When sufficient funds have accumulated, the project can be initiated. The problem occurs when the regional pond program cannot be implemented for several years after development occurs. Over time, the degradation of the stream is accelerated, causing the need for further stream stabilization remedies, thus increasing the financial resources needed for interim and permanent programs and projects to protect and preserve the stream system. Thus, to avoid unnecessary degradation and the ensuing costs to correct it, the required stormwater controls need to keep pace with development of the watershed.

As noted in the Ecology section, the County currently does not require temporary on-site stormwater management ponds except in the Occoquan Watershed, a condition imposed to protect the water supply. The ecological impacts associated with this situation can have economic ramifications: additional and planned downstream streambank stabilization projects may need to be pursued at an earlier date; streambank erosion may result in the loss of land, affecting property value; erosion may affect the aesthetic quality of streams, which could affect property values; erosion may threaten infrastructure (trails, water lines, sewer lines, roads, etc.); and there may be a need for increased frequencies of dredging of ponds and lakes due to an increase in sediment generated by streambank erosion. Increased erosion and sedimentation inhibits the living resources of the Chesapeake Bay and its tributaries and increases costs to protect them.

In some cases, especially in the Occoquan Watershed, where water quality controls are required, temporary stormwater management facilities are put in place to meet the normal development requirement to provide water quality control. These temporary facilities are constructed upstream of planned regional pond sites. The temporary facilities may or may not be removed once a replacing regional pond is constructed. In the case where they are not removed, the temporary ponds may continue to require maintenance resources. However, these temporary ponds may be removed if the replacing regional pond achieves the required quantity and quality controls. This duplication of effort results in added costs for removal of the temporary facility, as well as the original capital costs of the temporary facility, both of which could have been avoided if the permanent regional pond had been constructed prior to development.

In a program relying on regional ponds, the lots, where temporary or on-site facilities may lie, may become suitable for development. From a developer's point of view, he or she may gain an economic benefit by being able to redevelop a lot containing a temporary pond or on-site pond, which is no longer needed due to construction of a regional pond.

In many instances a developer can achieve the maximum lot density for a site regardless of the ability to rely on off-site controls, i.e., regional ponds. However, an off-site regional facility may result in a more favorable lot layout from a homeowner standpoint. Because no extra outlot is needed for stormwater management controls, there may be more land area available on the developing site to achieve the same density. If an on-site pond is not built, land area may be saved as open space, also benefiting the community. On commercial sites, where the land usually is more expensive, eliminating or decreasing the number of on-site facilities may improve the capital investment rate of return because no facility is constructed. The floor area ratio usually is optimized for the site regardless of regional ponds, mainly because opportunities for underground controls are more prominent in commercial areas.

C – Local, State, and Federal Permits, Regulations and Policies

Stormwater facilities, which control peak flow, volume and pollution, are frequently referred to as stormwater management/best management practices (SWM/BMP) facilities. Neither on-site nor regional SWM/BMP facilities can be designed to eliminate 100% of the pollutants that flow into them. On-site SWM/BMP facilities generally can serve to minimize the increase in pollutant runoff from development sites, but in most cases do not treat previously developed or off-site drainage areas. In contrast, regional SWM/BMP facilities can be located so that they will treat uncontrolled stormwater runoff from previously developed properties. In this manner, the implementation of regional SWM/BMP facilities can provide for overall net reductions in pollutant loadings for a region. This is noteworthy in light of recommendations from the Chesapeake 2000 Agreement that calls for reductions in both nutrient and sediment loadings. The June 28, 2000 agreement reaffirms the commitment of Virginia and other localities to protection and restoration of the ecological integrity of the Bay.

Regulatory matters can be considered from both an external (federal and state) and internal (Fairfax County) perspective. From an external perspective, regional ponds may be more difficult to implement than on-site facilities because of the greater likelihood that regional ponds will result in wetland impacts. Disturbance of wetlands can involve considerable time and expense to obtain federal or state permits. From an internal perspective, until recently any innovative stormwater management practice, such as rain gardens (planting beds consisting of a vegetated surface layer, planting soil, and optional sand bed), required a submission and approval of a request for modification (frequently referred to as a waiver) of the standard requirements contained in the Fairfax County Public Facilities Manual (PFM) to allow an alternative means of achieving the required performance. An engineering study documenting the effectiveness of the innovation also was required. The extra effort and associated costs involved in approval of innovative practices have slowed the use of these techniques by the development community. As of October 2001, ten innovative practices (including rain gardens) were deemed acceptable tools that no longer require submission of a waiver request or special engineering studies.

In general, the construction of a regional pond is more likely to impact wetlands than is the construction of on-site stormwater management facilities, which are normally located outside of stream valleys or higher in watersheds. However, a comprehensive regional stormwater management program may allow the County to identify overall cumulative wetland impacts and develop a comprehensive mitigation program that would reduce paperwork and streamline the legal requirements. The current individual regional pond and on-site facility planning processes, where the impacts of pond construction cannot be forecast, work against developing a comprehensive, countywide mitigation or compensation program. Nevertheless, currently it may be possible to mitigate for a significant part of the wetlands lost by regional pond installation through replanting efforts within the ponding areas.

An additional regulatory consideration associated with regional ponds concerns consistency with Virginia's Chesapeake Bay Preservation Area Designation and Management Regulations (the "State Regulations"), as implemented in Fairfax County through Chapter 118 of the County Code (Chesapeake Bay Preservation Ordinance). Due to their locations along the main stems of streams, several of the County's regional pond sites are located within Resource Protection Areas (RPAs) as defined by the Ordinance. Forthcoming revisions to the Ordinance probably will result in an expansion to the RPA network, thereby increasing the number of regional pond sites that will be located in RPAs. Currently, an administrative exception must be obtained in order to construct any stormwater management facility in an RPA. Under the recently revised State Regulations, regional ponds may be allowed in RPAs subject to a number of criteria. Upon consideration of revisions to the Chesapeake Bay Preservation Ordinance, the Board of Supervisors will determine if this allowance will be incorporated into the Ordinance.

The October 2000 amendment to Fairfax County's Policy Plan supported the application of low-impact site design techniques in order to reduce stormwater runoff volumes and

peak flows, to increase groundwater recharge, and to increase preservation of undisturbed areas. The focus of these techniques is the reduction of stormwater runoff from development sites (through minimization of impervious surfaces and on-site retention and/or infiltration of runoff) rather than the conveyance of runoff to downstream areas. The on-site emphasis of this approach, which is consistent with approaches that are being recommended by the Center for Watershed Protection (a national organization dedicated to promoting BMPs and policies to preserve and improve the nation's water quality through watershed resources) and the Chesapeake Bay Local Assistance Department (and that are being pursued by other localities, most notably Prince George's County), may conflict with the regional approach, which emphasizes regional controls over on-site controls.

D – Hydrology and Design

Regional ponds are designed to meet peak-shaving runoff control for 2-year and 10-year storm events for the purpose of controlling erosion and flooding, thereby achieving the design standards and criteria of the Fairfax County PFM. Extending the detention time (up to 48 hours) improves the efficiency of these facilities to remove pollutants, meeting water quality control requirements. Although on-site detention facilities are designed to achieve the same benefits, a regional pond system designed as a network can prevent cumulative impacts of scattered on-site detention ponds on peak discharges to the stream system. This effect is achieved by preventing the occurrence of coincident peak discharges as can occur from a system of several on-site ponds (as described in the next paragraph).

The benefit of a detention facility in controlling peak flow is a function of timing of its discharge, the timing of the peak discharge in the stream and travel time of these flows to a downstream point of interest. If a pond is far enough upstream and the travel time of its peak discharge is greater than the downstream time to peak, then the downstream area would not detect the peak flow reduction from the pond, until after the peak flow in the stream occurs. Similarly, if the pond is too close to the point of interest, the travel time of the peak allows the flow to pass before the peak in the stream occurs. In the County's regional pond plan, the travel time was modeled to the mouth of the watersheds to identify the most effective locations of regional ponds for reducing flows in the stream system. Thus, with all of the planned regional ponds strategically located and working together as a system, cumulative impacts on the stream system are minimized and runoff rates more simulate those of undeveloped watersheds (Regional Stormwater Management Plan, County of Fairfax, Final Report, CDM, 1989). Conversely, an approach that relies on a larger number of on-site stormwater management facilities would not provide for coordination of discharges from the numerous facilities in any one watershed, especially if some end up not being installed. The result may be adequate controls immediately below individual development sites but inadequate stream protection where peak volumes of flow from several development sites coincide with one another.

Regional ponds are designed to achieve water quality and quantity controls for their entire contributing watersheds. As they are located further downstream compared to on-site facilities, they have the opportunity to control previously uncontrolled runoff from the existing road system and existing structures or developments constructed prior to the County's adoption of on-site detention requirements during the early 1970's. In a system of on-site controls, the individual developments provide the required controls for their sites only, not necessarily for the contributing watersheds to those new facilities. Controlling any area other than the area undergoing development is an increased expense to the developer and is not a requirement to meet the standards and criteria even though future development may render the facility as undersized. However, because regional ponds are located further from pollutant sources (the contributing watersheds being 100-300 acres in size), they become less effective at controlling pollutants nearer to the source. Because of this, the impacted area exposed to the runoff is greater as compared to controls that are incorporated into the individual development sites.

In the County's regional pond plan, where topography permits, the regional ponds are planned to provide maximum efficiency, or additional flow reduction and a greater pollutant removal rate, by taking advantage of maximizing the storage capacity within the pond. The release rate from the ponds is set at 1/3 of the predevelopment (undeveloped) peak flow. The result of providing the maximum efficiency design is that flow reductions are seen immediately downstream of the regional pond even though the duration may be increased resulting in a net increased erosion impact. In effect, these facilities act as a way to provide flow reductions for uncontrolled areas outside the immediate watershed of the pond. While achieving greater water quality and flow reductions with these maximum efficiency designs, the pond and embankment require a larger footprint area and, therefore, a greater potential for environmental impact to the fringe areas of what would normally be the pond limits. Also, as the regional pond size is increased, more stringent design standards may apply, requiring even larger facilities, such as principal and emergency spillways, and wider embankments that contain safety benches because of the higher embankments.

The PFM credits BMPs (structural or nonstructural methods designed to minimize impacts of change in land use on surface and groundwater systems) with various levels of phosphorus removal efficiency. (Phosphorus is an indicator of water quality. Measures that control phosphorus also will control many other pollutants.) Regional ponds are credited with having a certain level of effectiveness in removing phosphorus, which is higher than the level of on-site BMP ponds. This is due primarily to their size as well as to runoff from existing development outfalling through them.

The opportunity to achieve better pond designs is greater for regional ponds than for on-site ponds because, generally speaking, there is more land area available to design regional ponds. Regional ponds are located in stream valleys, taking advantage of the topography and requiring less regrading of the land. On-site ponds often are "carved" into the land, located at the perimeter of a development (which does not necessarily follow natural drainage divides), and designed to have the smallest footprint possible. If

a pond is designed to increase pollutant particle travel length, the pollutant removal efficiency is increased. If the pond's inlet is relatively close to the outlet structure, as is the case with many on-site detention ponds, the flow path is short-circuited. Regional ponds offer opportunities to design a facility that is elongated, providing an increased particle travel length. This principle, which is important in achieving the pollutant removal efficiency level for which credit is taken, often is overlooked in the design of detention ponds, as there is no specific criteria in the PFM to require its consideration.

The effect of regional ponds on water quality downstream from the pond is complex and depends to some extent on the configuration or shape of the pond. The storage volume of permanent pools and volume of dry storage in wet ponds play a significant role in particulate settlement. The location of the water release system, in relation to the pond inlets where the travel length within the pond is increased rather than allowing particle short-circuiting, increases the pollutant removal efficiency (VA Erosion and Sediment Control Handbook, Std & Spec 3.14). The higher pollutant removal efficiency of regional ponds can be attributed to their larger surface area and the additional travel length of pollutant particles once entering the facility.

Dry regional ponds where wetland vegetation becomes established in the lower areas also have high pollutant-removal and nutrient-loading capabilities due to filtering effects of vegetation and nutrient uptake by vegetation.

Regional ponds generally have larger earth embankments than on-site ponds. The storage depth fluctuations in a regional pond can be near 20 feet in a larger regional pond, while about 8 feet to 12 feet is typical in similar on-site ponds. This fluctuation is designed to occur over a 48-hour period to provide enough time for pollutants to settle out of the runoff. The greater the depth of the fluctuation, the greater the footprint area that will be inundated for longer periods, potentially affecting vegetation and habitats within the pond floors. Some vegetation can withstand this fluctuation; the biggest concern is the back to back storm events that increase the time water is stored in the pond beyond the 48 hours. In comparing regional ponds with on-site ponds, greater depths will occur in one area (regional) where lower depths will occur in many areas (on-site). The designer should consider whether desired pond vegetation could withstand and thrive in an environment to the degree that the depth fluctuations will occur.

Regional ponds may be sited inappropriately and actually increase bedload (a movement of soil particles along a streambed) although they may prevent natural bed load transport in some instances. Since some natural bed load transport is important in maintaining stream stability, the net impact of regional ponds on the stream physical stability might have to be substantiated on a case-by-case basis. Regional ponds also are an efficient way of addressing flooding problems since they are designed to have a 'peak-shaving' benefit for 2-year and 10-year storm events covering larger drainage areas. These ponds reduce the potential for stream erosion and provide limited flood control, to achieve PFM design requirements. Although detention ponds are capable of controlling the magnitude of the post development peak discharge for the design storm

to its predevelopment level, the duration of the peak flow is increased and may exceed the receiving stream's ability to resist erosion. Channel erosion is accelerated in these cases. Also, detention ponds are not designed to reduce runoff volume or to infiltrate runoff into the ground (volume control is not an ordinance requirement), and therefore may not always be effective in reducing downstream erosion.

E – Land Use and Watershed Management

In the last fifty years, Fairfax County has been transformed from a largely rural, low-density residential community to the most populous jurisdiction in the Washington, D.C. metropolitan area. Between 1970 and 2000, the County's population more than doubled, from 454,275 people to 964,712 people. Growth in employment also has been substantial; the number of people employed in Fairfax County (exclusive of agricultural employment) grew from 371,716 in 1990 to 541,132 in 2000. Growth is expected to continue; according to the County's web site, the County's projected populations for the years 2010 and 2025 are 1,123,128 and 1,192,289, respectively.

The County's recent history of growth has had a profound effect on land use, and land use conditions can be expected to change as the County continues to gain population and employment. However, the character and patterns of future development in Fairfax County will differ from what the County experienced in the latter half of the 20th Century, simply because relatively large tracts of vacant land no longer are prevalent in the County. A "Fairfax County Profile" prepared by the County's Office of Research and Statistics in February, 1975, for example, identified 91,782 acres of vacant land in Fairfax County (excluding the Towns of Clifton, Herndon, and Vienna). This represented nearly 36% of the County's land area. By 1985, the acreage of vacant land had been reduced to 66,685, or just over 26% of the County's land area. In January 2000, only 29,235 acres of vacant land (under 11.5% of the County's land area) remained. While there is additional "developable" land available in the County (the County's 1999 "Demographic Reports" indicated that 17.3% of the County's planned land was either vacant land or underutilized residential land), larger tracts of developable land are diminishing in number, and substantial changes in the overall distribution and character of land use in the County are not anticipated. Rather, future population and employment growth increasingly will be accommodated through development on relatively small parcels adjacent to or within established areas (infill development) or through redevelopment of previously developed land.

The urbanization of the County's land use pattern is evident in the areas upstream of sites that have been identified for regional pond construction. Regional pond sites were selected to collect drainage from watersheds that had a significant development potential. Current land use conditions upstream of many of the unbuilt regional pond sites indicate that many of these watersheds now are largely developed. County staff has evaluated land use conditions above 97 sites for which regional ponds are proposed but not yet constructed or completed. Watersheds above these pond sites are typically over 80% developed (that is, there is less than 20% vacant land and

underutilized residential land), with an average developed condition of 86%. Only four of the 97 watersheds has more vacant land and underutilized residential land than developed land, and only 22 of these watersheds have 25% or more of such lands.

Vacant/Underutilized Area in Regional Pond Drainage Areas Summary by Watershed

Watershed	Drainage area of regional ponds (acres)[1]	Vacant or Underutilized Area (acres)[2]	% Vacant or underutilized[3]
Accotink Creek	1,063	89	8.3
Cameron Run	465	39	8.4
Cub Run	4,562	1,080	23.7
Difficult Run	12,458	1,398	11.2
Dogue Creek	150	29	19.4
Horsepen Creek	1,658	112	6.8
Little Rocky Run	1,793	400	22.3
Pohick Creek	1,315	155	11.8
Popes Head Creek	209	6	3.0
Sugarland Run	916	96	10.4

[1] Total drainage area of existing and proposed regional ponds.
[2] Vacant and underutilized area within the regional pond drainage areas.
[3] Expressed as a % of total regional pond drainage area.

From a stormwater management standpoint, the evolution from large-tract development to infill development and redevelopment presents both challenges and opportunities. Traditional approaches to stormwater management may not be practicable or effective on small infill development sites, and a proliferation of small, on-site detention facilities may result in a stormwater management system that provides controls for individual development sites but does little to protect the overall stream system. Opportunities may present themselves, however, through the redevelopment of parcels of land for which stormwater management controls to date have been limited or nonexistent. Further, watershed-wide stormwater management planning efforts also may be able to consider potential infill and redevelopment projects within a larger context, thereby providing for an integrated system of stormwater management measures that can optimize downstream protection.

Outside of the Occoquan Watershed and portions of the Difficult Run Watershed, development in Fairfax County generally has not been planned based on watershed or environmental sustainability considerations. Further, because much of the County already has been developed, opportunities for additional watershed-based land use planning efforts may be limited. However, the County now is embarking on a multi-year effort to plan stormwater management systems on a watershed-wide basis, with a focus on minimizing and/or managing stormwater runoff in a manner that, to the extent practicable, will provide for the protection and restoration of the ecological integrity of the County's streams. This effort will not be limited to a consideration of traditional structural controls; while much remains to be determined, it is anticipated that the

consideration of existing land use conditions, potential land use changes, low-impact development practices, and stormwater retrofits will be integrated into the development of watershed-specific stormwater planning strategies. To date, the County has not pursued such an approach to the management of its water resources. The Stream Protection Strategy (SPS) effort described earlier in this report was the first component of this larger effort.

F – Parks and Recreation

As noted earlier in the report, under the current County program, regional ponds are located along the main stem of streams. The Fairfax County Park Authority (FCPA) owns and operates many of the County's streams and their adjacent lands as Stream Valley Parks. The Park Authority objectives for Stream Valley Parks are to conserve ecological habitat, protect land and water resources, and preserve open space. FCPA believes that construction of regional ponds on park property largely conflicts with the objectives for Stream Valley Parks. Because of the perceived conflicts, FCPA policy is to discourage the siting of regional ponds on parklands (FCPA Policy Plan, Policy #304, p. 300.7). FCPA's primary concerns are related to adverse environmental and cultural resource impacts, liability issues, and the loss of valuable land that could be used for park and recreational purposes.

Because regional ponds tend to provide downstream stream bank protection, the upstream portions are left unprotected and the natural habitat of the stream valley often is severely degraded. These and other ecological impacts include loss of stream habitat in the ponded area, blockage of fish passageways, tree removal, and downstream stream bank damage during the larger storm events which conflict with FCPA natural resource management objectives.

Another concern relates to the use of public parklands for managing stormwater from private development. Because developers of properties upstream of regional pond sites generally do not need to provide on-site stormwater controls, these developers reap benefits from the regional pond program by gaining developable land that otherwise would be used for stormwater management. As a result, locating regional ponds on parkland essentially allows public lands to be used for private gain.

On the plus side, one potential advantage of regional ponds for park purposes is for boating and fishing use. However, of the many recreational services provided by the FCPA, these are two where the supply currently exceeds demand.

G – Health and Safety

With the passage of the Clean Water Act in the early 1970's and subsequent clean water legislation, Fairfax County and many other local jurisdictions in the Washington, D.C. Metropolitan area have endeavored to implement environmental strategies, not

just to curb the impact of continuing development on water quality, but also to restore areas damaged during the urbanization of the fifty-plus years pre-dating the Clean Water Act. Both on-site and regional ponds are among the many tools available in this effort. Ponds are vital to public health in that they help to clean up and restore the watersheds draining to the three large water resources located downstream of the County (i.e., the Occoquan and Potomac Rivers and the Chesapeake Bay). As these bodies are restored in environmental health, associated increases in overall public health will be realized.

Until recently, the impact of regional and on-site stormwater management facilities was not a major topic in the discussion of public health issues. On occasion, County staff has responded to complaints about the natural vegetation at some dry detention facilities creating a habitat for snakes and small rodents, which, in turn, could attract a larger population of predator species to residential areas. Although the “larger predator” issue never really materialized, there were a small number of incidents where harbored rodents ventured from a small dry pond into the backyards of a few property owners to feed upon pet food, garbage, and a few ornamental fruit trees. As with any “naturalized” environment, when wildlife takes up residence there always will be the potential that a rabid raccoon or other rodent also may be present. This is true in forested buffer areas just as much as in pond environments. Generally, these issues are and have been easily addressed through public education with respect to nature and improved private property housekeeping activities (i.e., elimination of food sources, etc.).

Of more recent concern, however, are the incidents of mosquito-transmitted diseases. In recent months, health officials have reported several cases of the West Nile Virus and of the “non-deadly” vivax strain of malaria. These cases have heightened the awareness of and alarmed the general public about the potential problems associated with increased mosquito breeding caused by standing water conditions. Given that the floors of many dry ponds often contain one or more irregularities that result in the creation of small pools of standing water, mosquito-breeding problems invariably occur. However, shallow marsh wetland dry ponds pose less of a mosquito problem than conventional “draining” dry ponds. Although it may seem counterintuitive, naturalized wet areas (i.e., wet meadows, wetlands, forested floodplains, etc.) are less susceptible to the uncontrolled proliferation of mosquitoes than are "maintained" areas. Naturalized areas promote the development of natural biologic controls (e.g., frogs, dragonflies, damselflies, water striders, salamanders, bats, and some flycatchers) through ecosystem development, while maintained areas provide no such controls. Nature, it seems, is the best defense against nature as it continually strives for equilibrium.

Because most regional ponds are located in floodplains, the impoundment habitat typically already will contain the presence of the aforementioned biologic controls. Dry regional ponds typically provide a more suitable mosquito habitat than that provided by wet regional ponds. However, through the use of constructed wetland zones in the impoundment areas of dry ponds, increases in mosquito activity over that of the typical wet pond or floodplain area should not be realized. Similarly, with the installation of shallow marsh wetlands in on-site dry ponds, increases in mosquito activity should not be experienced. Essentially, the only difference in this respect between a regional pond

and an on-site pond as a mosquito habitat is the proximity of the facility and its associated wildlife activity to residential property.

Since regional ponds control much greater drainage areas (the average drainage area of all regional ponds in Fairfax County is 331 acres) than those controlled by on-site dry ponds (the average on-site dry pond drainage area is 16 acres), the potential for the regular trapping of pollutant loads (e.g., eroded stream bank material, petroleum products, wildlife fecal matter) is higher than that trapped at on-site dry ponds. The fact that regional ponds tend to be located farther away than on-site ponds from residential properties is a greater safeguard against human exposure to these pollutants.

As noted earlier in the report, wet ponds maintain a permanent water surface, while dry ponds drain down to a dry or semi-dry state within three days following a rain event. With respect to safety, there are considerations associated with both wet and dry ponds. These considerations apply to on-site as well as regional facilities. Wet ponds create recreational opportunities and serve as aesthetic amenities within communities, parks, and commercial locations. Although the permanent water surface poses significant risk factors to the user, most people either are used to living near or are somewhat familiar with bodies of water (e.g., lakes, large streams, the ocean, and even swimming pools). They generally recognize the potential danger associated with visiting or recreating at such locations (i.e., drowning, being harmed by an animal, etc.). Although several drowning cases have occurred in the County's large regional lakes, these lakes draw many visitors and general safety is maintained through the vigilance of the entities responsible for their up-keep and the willingness of visitors to observe the regulations posted at each site. That being said, the safety risks associated with wet ponds should be acknowledged.

Stormwater management facilities can pose significant safety risks for those individuals who are not aware of the dangers associated with the intermittent ponding of water that occurs at these facilities. Since 1980, there have been eight incidents of drowning in County-maintained wet facilities. In June 2001, a drowning occurred in a dry on-site pond facility. The outlet structure had been vandalized to prevent the release of ponded water. The victim was a neighborhood child who lived about 150 feet from the pond and, while playing near the water's edge, slipped into the water. The child did not know how to swim. Fortunately, because dry ponds do not readily attract visitors and because they do not maintain a permanent body of water, the safety risks at such a facility tend to be far below those of a wet pond.

It is the opinion of the Office of Risk Management, the Wyatt Company (a world-wide risk assessment consultant), and County staff that the dry pond design generally provides a safer facility and poses a reduced liability risk than that of a wet pond. However, continual public outreach illuminating the risks associated with both wet and dry ponds is ongoing.

In terms of regional vs. on-site facilities, regional facilities tend to be sited a farther distance from residential properties than on-site ponds. While it is recognized that a child playing at a regional pond may be more out-of-sight than a child playing at an on-

site pond may, it is generally recognized that far more “unsupervised” child activity occurs at on-site ponds due to their close proximity to residential property.

Though it is not often considered, maintenance activities at a particular pond can pose a safety risk to either the operator of a piece of equipment, or a nearby resident, or both. Though the size of the equipment used at a regional pond tends to be larger than that used at an on-side pond, the use of heavy construction equipment does pose a litany of safety concerns when operated near residences. Because maintenance activities at a regional pond tend to be located farther away from residential homes, the potential for safety incidents between an equipment operator and a resident or a child are significantly reduced.

Wet ponds pose a greater safety risk than dry ponds to those maintaining the facility. Because of the permanent water surfaces, maintenance activities related to the care of the principal risers and spillways of wet ponds often involve the use of boats, ladders, harnesses, life-preservers, and scuba gear. In addition, the use of electrical equipment within close proximity of a water surface must be performed with extreme care. In most instances, battery- or air-powered devices can be used, but, occasionally, electric generators are required to perform tasks that cannot be performed with only battery- or air-powered equipment. In addition, operating the low-level release valves at these facilities in preparation and during extreme weather events can pose unique safety problems to operations personnel.

Regional ponds, in general, pose greater dam safety risks than on-site ponds, and, similarly, wet ponds tend to pose greater safety risks from dam breaches than dry ponds. Due to the size of the dam at regional facilities, much greater evaluation of the effects of a dam breach on downstream property must be taken into consideration. While the breach of a typical on-site pond dam may cause some erosion and environmental damage downstream, the breaching of a regional pond dam can result in a much greater impact. Impoundments or dams, for facilities such as lakes and ponds, are classified based on their downstream hazard potential. If breached, a high-hazard dam could result in significant loss of life, destruction of residential and business property (i.e., homes, buildings, etc.), destruction of transportation infrastructure (i.e., roads, bridges, the Virginia Railway Express, etc.), damage to utilities (i.e., gas transmission lines, electric power substations, etc.), and disruption to intra- and interstate commerce. Because of these issues, regional pond dams are designed and constructed to a far greater standard than on-site pond dams. In addition, existing legal provisions require a much higher level of inspection and maintenance service as well as the preparation and maintenance of site specific emergency action and evacuation plans created to address high-hazard situations.

In order to minimize safety concerns and the risk exposure of the County, several actions were implemented in the early 1990’s. These actions, which are listed below, were adopted at the recommendation of the Safety and Liability Task Force for Stormwater Management as presented in their January 1989 report. The Board of Supervisors established the task force in 1987 to assess the safety and liability issues

of stormwater detention ponds and the long-range financial implications of addressing those issues. The Board took the following actions:

- Approved the Regional Stormwater Management Plan, initially identifying 134 regional facilities.
- Prohibited the installation of stormwater management facilities on private residential lots.
- Encouraged the use of dry and extended dry stormwater management facilities for all on-site and regional locations, except where the County's Regional Stormwater Management Plan specifies a wet BMP pond.
- Restricted the use of wet stormwater management facilities in residential areas, except in the instances where a regional wet facility is specified in the Regional Plan.
- Included, in the PFM, wet pond design features that may reduce safety concerns and risk exposure. Examples of such features include flat, shallow underwater shelves on the lake perimeter; plantings on this shallow shelve to discourage lake access, and advisory signs prohibiting swimming and ice-skating.
- Approved posting signs around the County's large regional wet ponds (i.e., Lake Royal, Lake Barton, etc.) promulgating the use regulations adopted by the Board of Supervisors (i.e., no motorized boating, no swimming, etc.).

H - Aesthetics

Regional ponds (particularly wet regional ponds), when well designed, well located, and adequately maintained, add a premium to properties located nearby compared with the same properties remote from the pond because of their aesthetic value. The premium remains, and may even increase, over time if the pond is adequately maintained but also can decrease if it becomes blighted.

As beauty is in the eye of the beholder, it is difficult for any one person to make conclusions for all others regarding the competing aesthetic values of various pond designs and observers. The aesthetic considerations of regional ponds are of importance, however, due to the size and prominence of these facilities. A certain percentage of the population prefers a typical dry pond design consisting of a grass basin, preferably without a concrete trickle ditch. Others find the typical dry regional ponds to be unattractive, possibly because of the concrete trickle ditch, possibly because of the stark gray concrete riser, or possibly because of the bastion-like qualities of the water control intake. Trash and debris tend to accumulate in stormwater management basins adding to their aesthetic impact. Regional as well as on-site ponds are vulnerable to vandalism and their relatively large control structures are inviting targets for graffiti artists. Tree retention and plantings in portions of the retention basins are being employed as alternative design options for dry facilities. Wetlands are being created in existing dry ponds to enhance ecological value and aesthetics. Some regional dry ponds require a significant amount of woodland clearing to provide for embankments, control structures, and maintenance access roads even for those

facilities that typically are considered to have the lowest potential to be intrusive such as embankment-only facilities.

There is an Andropon Associates Brochure that says that "Water is a living system, an essential element. We should celebrate it in the landscape, not put it into a pipe." Aesthetics is the appreciation and the creation of the tasteful and the beautiful. Water very often is considered an aesthetic element and important in natural and manmade landscapes. Over the years people have chosen to live near water and gravitate to it for solace, recreation and inspiration. Building lots next to clean lakes, rivers and streams, not to mention the ocean, usually have high values and sell at a premium, which reinforces perceptions. This reflects our almost innate appreciation of water on many levels. In a more natural environment, streams would have gradual drops, curves and meanders, and more rainwater would infiltrate into the vegetated ground rather than run off over paved surfaces and increase the chances for downstream flooding. Dry ponds do not offer any of this.

Humans place high values on undisturbed natural landscapes and seek to visit and live near those places. The conventional approach to treating stormwater runoff has been to view it as a drainage problem and to "solve" the problem with traditional engineering solutions. Drainage engineering structures such as inlets, pipes, culverts and dry ponds are built to carry “excess water” from a site as quickly as possible. This excess stormwater, pulsating from an altered environment, causes flooding, erosion, and sedimentation in downstream channels. This results in altered and degraded stream channels.

Traditionally engineered storm drainage solutions are expensive, require constant maintenance, affect natural habitat, and usually are less attractive. In contrast, newer "soft" design solutions such as hidden groundwater recharge beds and vegetated drainage swales easily blend into the natural environment and are less visually obtrusive by replicating natural drainage conditions. These new designs slowly are being implemented within the County and create a sense of harmony and visual attractiveness. Good stormwater designs blend into the natural environment, mimic the natural environment, and work with natural elements whenever possible.

I – Construction Planning and Phasing

While the regional pond program has been established in part to reduce the number of smaller on-site stormwater management facilities required, the program does not preclude the ability of the County to require temporary on-site stormwater management facilities prior to the construction of the downstream regional pond. In the Occoquan Watershed, for example, temporary on-site BMP facilities typically are installed prior to the regional pond being constructed.

However, as noted earlier, on-site stormwater management measures typically are not pursued on properties that are developing upstream of regional pond sites, even where

the construction of the regional ponds may not occur for years or may never be implemented. Data have not been compiled regarding how many such properties have developed without on-site stormwater management controls (it is anticipated that this will be a consideration during the watershed management planning process), but the Subcommittee believes that the number is significant. The lack of temporary stormwater management controls can result in increased streambank and streambed erosion in downstream areas. Where temporary on-site measures are provided (e.g., BMP facilities in the Occoquan watershed), the cumulative amount of land disturbance associated with stormwater management and BMPs is higher than it would be without the regional facility. Furthermore, there are no standard approaches to the disposition of temporary stormwater management control sites after the regional pond has been constructed. In some cases, a "temporary" facility may become permanent (requiring continuing maintenance) if the downstream regional pond is not constructed. Conversely, in some cases the temporary control site may revert back to open space or be developed after the regional facility is constructed.

J – Public Participation, Outreach and Support

Currently there are two methods of implementing regional pond projects. Regional ponds are implemented either through the development process or through the capital project process. Each of these methods of implementation allows for the involvement and participation of the public. With capital projects, the public participates through public meetings at various phases of the project. The degree of public participation varies when regional ponds are designed and constructed through the land development process. In the case of by-right developments (developments pursued in accordance with existing zoning), owners of properties abutting the proposed regional pond site are notified of the developers' intent as a part of the plan approval process. If the development is through the process of rezoning or if it requires a Special Exception, public concerns can be aired during hearings before the Board of Supervisors and the Planning Commission.

Where regional pond implementation is attempted in already-developed areas, significant community opposition can develop. Regional pond sites typically are located in wooded stream valley areas, and many citizens prize these areas for their ecological, aesthetic, and passive recreation values as well as for the benefits that these areas can have on their property values. Because many residents may not aware of the regional pond program and specific sites identified for pond construction, there may be widespread community assumptions that sites intended for regional ponds will be protected as undisturbed open space. When residents discover that this "open space" will be lost, opposition to the implementation of the regional ponds can be expected.

Staff has not devoted substantial resources to explaining to the public the importance of regional pond projects. From a "lessons-learned" standpoint, this can be corrected, especially through the forthcoming public involvement efforts associated with the

development of the watershed management plans and the use of more citizen-friendly design concepts.

K - Stormwater Management in Other Jurisdictions

Stormwater management policies and guidance for the states of Virginia and Maryland, and a number of surrounding counties in these states were examined to determine their approach to regional versus on-site stormwater management.

Commonwealth of Virginia - In 1999, the Virginia Department of Conservation and Recreation published the Virginia Stormwater Management Handbook, (Handbook) (http://www.dcr.state.va.us/sw/stormwat.htm) to serve as the primary guidance for stormwater management programs. According to the Handbook, "The development of a regional stormwater management plan allows a local government to strategically locate stormwater facilities to provide the most efficient control of localized flooding, stream channel erosion, and water quality."

The Handbook states that stormwater management concerns in a given watershed are addressed with greater economy and efficiency by installing facilities based on a regional stormwater management plan rather than on individual, site-specific facilities. The Handbook further notes that while the benefits of regional stormwater management plans are well documented by localities that have implemented them, adverse impacts also have been documented. A list of issues including asserted problems with on-site facilities, asserted benefits of regional facilities, and possible adverse consequences that may result from regional facilities is provided. The Handbook suggests that the debate over the merits of regional facilities versus their impacts will be different in each watershed.

State of Maryland - The Maryland Stormwater Design Manual, Volumes I & II (http://www.mde.state.md.us/environment/sma/stormwatermanual/download_manual.htm) published in 2000 by the Maryland Department of the Environment (MDE), serves as the official guide for stormwater management principles, methods, and practices. MDE also has published a model stormwater management ordinance (http://www.mde.state.md.us/environment/wma/stormwatermanual/model_ordinance.pdf) that provides the minimum content for implementing and enforcing Maryland's stormwater management program consistent with the state code. Neither document uses the term "regional stormwater management." However, the documents define "off-site stormwater management" to mean the design and construction of a facility necessary to control stormwater from more than one development.

In general, while the Maryland Stormwater Design Manuals and the model stormwater management ordinance do not appear explicitly to encourage regional approaches to stormwater management, it appears regional approaches to stormwater management are recognized as acceptable components of broader watershed management plans.

Prince William County, Virginia - The County's current stormwater management policy appears to mirror Fairfax County's policy to a large extent. Section 700 of the Prince William Design and Construction Standards Manual (http://www.co.prince-william.va.us/planning/dcsm/dcsm0700.pdf), which includes information on policies and regulations related to storm drainage, states: "The County encourages the construction of regional SWM facilities as opposed to numerous on-site facilities where possible." Prince William County has a stormwater utility fee program to fund its stormwater projects.

Loudoun County, Virginia - All stormwater management facilities in Loudoun County are privately owned and maintained. For the foreseeable future, it does not appear that the County plans to build publicly owned facilities. The County encourages the incorporation of low-impact development (LID) practices into storm drainage design. The County's general requirements for SWM also include the following about "centralized" and regional facilities: "Centralized stormwater management facilities shall be incorporated within all proposed developments unless low-impact design is proposed in accordance with the provisions contained in this chapter or alternative measures have prior approval by the Director. Centralized stormwater management facilities shall be sited within the development to minimize the number of facilities required to serve the property and to maximize the effectiveness of the facilities."

Henrico County, Virginia - The County recently has developed and adopted a watershed management program to improve water quality in the County's streams. Prior to the adoption of the program, water quality goals were met primarily through on-site BMPs. Henrico County's policy on regional stormwater management and BMP facilities in their watershed program states the following: "In addition to the privately-owned regional BMPs, the County will begin to develop publicly-owned regional BMPs as part of the Stream Assessment/ Watershed Management Program. In order to finance these BMPs, a portion of the Environmental Fund will be set aside each year. It is the County's intent to design and construct publicly owned regional BMPs as funding is accumulated over a five to seven year period." Henrico County has a stormwater utility fee program to fund its stormwater projects.

Montgomery County, Maryland - Based on information obtained from staff (Watershed Management Division, Department of Environmental Protection, Montgomery County), it appears that Montgomery County does not encourage regional approaches to stormwater management, and in general, on-site controls are implemented. While a number of facilities that serve relatively large drainage areas exist, these were not constructed in accordance with a regional stormwater management plan. The construction of off-site facilities for SWM is considered only when development conditions and/or space limitations preclude an on-site facility. Montgomery County has a stormwater tax to fund its stormwater program.

Prince George's County, Maryland - Based on information obtained from staff (Programs and Planning Division, Department of Environmental Resources, Prince George's County), it appears that Prince George's County policy on stormwater

management is similar to that of Montgomery County's. Prince George's County is the developer of the integrated site design approach known as low-impact development. In fact, staff from Prince George's County suggested that on-site facilities based on low-impact development concepts could essentially mitigate any stormwater related water quality and quantity problems. Prince George's County has a stormwater tax to fund its stormwater program.

III - An Ideal Stormwater Program

A – Ecology

The goals of the ideal stormwater management program would be to preserve, protect, and enhance the County's ecological resources and to minimize pollutant runoff while providing a perfect balance between supports for the ecosystem and Countywide economic benefits. The ideal program also would maintain the integrity of stream valley ecosystems. With the ideal stormwater management program, there would be no adverse ecological impacts associated with stormwater runoff or with the approaches and facilities that are pursued or provided to control such runoff. The program would provide for stream protection and the recharge of ground water, and would facilitate stream restoration. This program would integrate various stormwater management options in a structured framework so as to create habitat and reduce runoff volumes generated by past, present, and future land development practices. The ideal program would be integrated with tree preservation and planting efforts through the preservation of special areas, resources, and parks.

B – Economics

The ideal stormwater management program would be fully funded. Implementation would be carried out in a uniform, systematic manner without funding constraints. A dedicated and reliable source of funding would be established to sustain the program. All stakeholders would contribute equitably, and the program would be administered in a cost-effective manner. All elements of the program would lend themselves to easy maintenance or would be self-maintaining. The number and types of facilities would not be limited by maintenance costs or other economic constraints. The ideal program would provide for facilities that enhance, rather than reduce, property values in surrounding areas.

C – Local, State, and Federal Permits, Regulations and Policies

From an external perspective, the ideal stormwater management program would be administered and implemented in such a manner as to make it fully compliant with all federal, state, and local regulations. From an internal perspective, the program would be supported by local ordinances and regulations, including the PFM, which promote innovation. The PFM would be flexible and its language crafted to anticipate future regulatory change. For example, Fairfax County's Policy Plan supports the application of low-impact site design techniques in order to reduce stormwater runoff volumes and peak flows, to increase groundwater recharge, and to increase preservation of undisturbed areas. The focus of these techniques is the reduction of stormwater runoff volume from development sites. In the ideal stormwater management program, this

focus would be accomplished through a combination of runoff reduction, retention, and/or detention practices, rather than the conveyance of runoff to downstream areas.

Waivers of requirements would be granted only when they support the ideal program and only under extraordinary circumstances. The ideal stormwater management program would provide consistency with County and regional policy by integrating on-site innovative approaches such as low-impact development, or (LID), with the larger, offsite methods of stream remediation or regional, extended detention/retention.

The ideal program would be based on a comprehensive watershed management approach within which regional stormwater management, as well as low-impact development and site design techniques, could be considered. The ideal program also would be developed such that it would consider the larger state and regional water quality context. The program would consider how stormwater runoff controls best could contribute to the removal of "impairment" designations to County waters and to the attainment of the goals of the Chesapeake 2000 Agreement.

The ideal stormwater management program would incorporate measures that would be consistent with all federal, state, and local laws and regulations and would minimize exposure to legal liabilities.

D - Hydrology and Design

The technical design aspects of the ideal stormwater management program would be based on the concepts of replicating the hydrologic cycle, removing stormwater pollutants through infiltration and vegetative treatment, and maintaining the natural flood ways (floodplains) to prevent flooding of structures and buildings during intense events. Wherever possible, the ideal program would de-emphasize structural approaches in favor of natural systems which include the ecological and flood attenuation functions of stream valleys. Where used, structural controls would be designed with multifaceted features capable of removing pollutants typically found in any environment. A strong research and development process that continually updates and improves designs through innovative practices would support the ideal program. Design standards would be simple to review and shall have documented benefits. The program and its measures would be performance-based and would set standards or benchmarks that can be replicated by others.

E - Land Use and Watershed Management

An important aspect of an ideal stormwater management program would be the management of runoff through land use planning, better site designs, and watershed management considerations. An integral part of this process would be the development of watershed management plans that: (1) link land use planning with stormwater management planning; (2) address all current and future drainage concerns

within the watershed; and (3) protect water resources within each watershed minimizing runoff at the source. A careful consideration of possible development and redevelopment scenarios in watershed and subwatershed planning efforts could identify opportunities for improvement through redevelopment and allow for determination as to whether stormwater management performance guidelines should be more stringent in some watersheds than in others. Through a systematic consideration of specific watershed and subwatershed conditions, the ideal stormwater management program would optimize the effectiveness of regional and/or on-site controls within each watershed and subwatershed.

F - Parks and Recreation

A major focus of an ideal stormwater management program would be the condition of the County's stream valleys and floodplains. An ideal stormwater management program would seek the active involvement of stream valley landholders, of which the Fairfax County Park Authority is a major one, and would provide stormwater management measures that would be sufficient to protect streams and floodplains from degradation. In addition, the feasibility of designing regional stormwater management facilities to augment the park system could be considered (e.g., through wet pond and/or wetland designs that may provide both habitat and passive recreational values). An effective way of maintaining the ecological integrity of the County's stream valleys is through preservation. An ideal stormwater management program that incorporates a park stream valley program into its watershed planning would preserve these natural resources. The ideal program also would promote stormwater management as multi-purpose facilities and amenities where consistent with the protection of ecological resources.

G - Health and Safety

The ideal stormwater management program would incorporate proven measures that provide facilities that minimize public health risks, including exposures to natural disease-carrying vectors, which may be caused by the existence, or the functioning, of these facilities. Ideally, a stormwater management program would promote the environmental health of the stream valley corridors and waterways and provide a safe and risk-free environment for owners, neighbors, visitors, and downstream properties. Liability exposure of the property owners would be minimized. Safety would be promoted through design standards and specifications, and by maintenance and operational practices. An ideal program would meet or exceed the federal, state and local dam safety regulations.

H - Aesthetics

The ideal stormwater management program would be based on systems that address all aesthetic considerations. Such systems would be aesthetically pleasing and blend

into the environment so that they are not generally noticeable to the public. Further, these systems would minimize the potential for accumulating trash and debris and would minimize vulnerability to vandalism.

I - Construction Planning and Phasing

In an ideal stormwater management program, planned facilities would be constructed and operational prior to the occurrence of development changes within the watershed. In such a program, planned facilities would be in place prior to the hydrologic changes caused by development of the upstream watershed. The ideal stormwater management program would have performance and design standards that could be measured and serve as a national model.

J - Public Participation, Outreach and Support

The ideal stormwater management program would include a very strong public outreach program that encourages public participation, educates the citizenry, and develops partnerships with regional and local stakeholders. All affected County residents would be aware of existing and proposed facilities, and support of these projects would be widespread among the citizens. Moreover, County residents would be willing to support funding of these projects. The program would fully involve stakeholders in the care of the environmental resources of the County and would foster pride in the community.

IV - Recommendations for Improvements to Fairfax County's Stormwater Management Program

The Subcommittee's study of Fairfax County's current stormwater management program, and in particular its regional pond policy, has identified a series of improvements that can be made in each of the study areas to move the current stormwater management program toward an ideal state. Many recommendations can be implemented easily through the cooperative effort of County agencies, the environmental community, the development industry, and homeowners. Several actions, such as revising regulations and devising totally new policies and procedures, involve major changes and will require more time to implement. The Subcommittee offers the following statements and recommendations.

A - Ecology

Enhanced Stormwater Management Pond Design and Alternative Stormwater Management Tools. Protecting and restoring the ecological integrity of stream valley ecosystems has not always been a priority in the design and construction of stormwater management (SWM) ponds. Under the current program most regional ponds are built in stream valleys and by their nature alter the stream corridor's ecosystems. At the same time, these ponds can minimize and mitigate adverse effects to the ecosystem if they are designed and constructed correctly. Ponds should be designed with the goal of protecting, restoring, and enhancing stream valley ecosystems. To date, the focus of SWM pond design has been largely on reducing erosion, flooding and, in more recent years, on reducing nutrient loading. Previously, it was thought that reducing the peak flow associated with the two-year storm would control downstream erosion. This assumption has not proven true. Additionally, regional ponds do not provide protection of stream segments in the drainage area upstream of the ponds.

1. **Pursue the goal of protecting and restoring the ecological integrity of stream valley ecosystems during the comprehensive watershed management planning effort currently underway for the County's 30 major watersheds. Long term, in-stream erosion control should be a standard component of the functional design of all watershed plans. The County should initiate ordinance, regulatory, and policy changes to incorporate preserving, restoring, and enhancing ecological integrity as a fundamental part of SWM system design. Among the elements to be addressed in these amendments are: adequate outfall requirements, thermal impacts, temporary on-site SWM prior to regional pond construction, and the application and encouragement of low impact development (LID) approaches for developing properties upstream, as well as downstream, of regional pond sites.**

2. **Consider regional ponds as one of many available tools for watershed management and incorporate this concept into the watershed management planning initiative. Prior to design of a regional pond and until watershed management plans are finalized, the County should conduct site-specific studies that consider alternatives to the ponds. These site-specific studies of alternatives should address items within a decision matrix which includes impacts to perennial streams and sensitive buffer areas, tree cover, the ecosystem, reduced contributing drainage areas, and overall hydraulic and water quality design. As part of the site-specific studies, a range of options should be considered to include reduced drainage areas upstream of the facilities, LID, and better site design methods. This approach would greatly lessen adverse impacts on the existing ecosystem while providing the level of stormwater management needed to handle the changes to stormwater quantity and quality resulting from development.**

Innovative Stormwater Management Practices and Cumulative Impacts. Many innovative stormwater management practices have been shown to protect the ecology of streams. Currently, the County does not promote or provide sufficient incentives for design flexibility using such innovative stormwater management practices. Currently, designs typically are based on processes that assure timely plan approval. Ordinances allow but do not encourage innovative solutions to SWM and do not address the cumulative impacts of piecemeal implementation of the stormwater management program.

3. **Provide incentives for the use of innovative SWM design solutions. Incorporate broader categories of innovative practices into County policies and regulations so that plans with innovative practices can achieve timely approval.**

4. **Revise ordinances, regulations, and policies to require each developer to design stormwater management measures to account for cumulative impacts to the watershed.**

Stream Protection and Restoration Goals; Criteria for Stormwater Management Waivers. Stream protection and restoration are not goals of the current regional pond program, either as originally envisioned or as currently required in the Public Facilities Manual (PFM). Habitat protection, habitat restoration and tree preservation, though not goals of the current regional pond program, are included in the PFM as desirable objectives. Incorporating these objectives into the regional pond program should make it more ecologically sound and make regional ponds, when determined to be the best SWM tool for a particular area, more acceptable to the general public. In cases where stormwater waivers have been granted based upon the planned future construction of regional ponds, but where construction has not occurred, stream conditions may have become degraded downstream of the pond site.

5. **Include stream restoration and protection as goals of the County's stormwater and watershed management programs. Apply these goals to regional ponds since such ponds are components of these programs. These goals should apply to all stream segments including those upstream of perennial segments. All stream segments should be considered for preservation and supplementation of vegetative buffers to preserve habitat and ecological integrity. The PFM should be modified to include habitat protection/restoration and tree preservation as part of the design criteria.**

6. **Revise the PFM to incorporate ecological criteria in the review of stormwater management waivers.**

Stormwater Quality and Quantity Controls for Older Areas. Older portions of the County were developed without stormwater quality and quantity controls. As redevelopment occurs, often no stormwater detention is required because there is no increase, or minimal increase, in imperviousness. Current redevelopment policies do not require the same degree of stormwater control as is required of new development. Therefore, there are missed opportunities for environmental enhancement and restoration.

7. **Implement and retrofit stormwater management practices in older portions of the County. Ordinances and policies should be amended to require, to the degree practicable consistent with revitalization goals, stormwater detention and water quality (BMP) controls for redevelopment.**

Groundwater Recharge. Consideration of groundwater recharge normally is not a priority in the Mid-Atlantic States because the region usually receives sufficient annual rainfall. Therefore, groundwater recharge is not currently a goal of the stormwater management program and not included in PFM requirements. However, because development produces impervious surfaces, which inhibit rainwater infiltration into the soil, groundwater recharge should be an objective of the County's stormwater management program. The County should encourage measures that promote stormwater infiltration into the water table. Infiltration measures will contribute to water recharge of aquifers, reduce the severity of runoff into receiving streams, and provide for adequate stream base flow.

8. **Include groundwater recharge as a goal of the County's SWM program and as a design consideration for regional ponds and any other measure that retains surface water for any purpose, when feasible. The PFM should be modified to encourage groundwater recharge.**

B - Economics

Adequate Funding. An indicator of a successful stormwater management program is the ability to implement all the stormwater management facilities and practices within a watershed prior to development. However, this effort has been thwarted in Fairfax County by the lack of a sufficient and timely funding source. Because of the limited amount of undeveloped land in Fairfax County, there are few opportunities to implement stormwater management systems for watersheds in advance of development. Funds for stormwater projects are currently appropriated to the Public Works Construction Fund, Storm Drainage Bond Construction Fund, Pro Rata Share Drainage Construction Fund, and could come from other sources in the form of developer agreements. There is a need to establish a dedicated reliable and adequate funding source to allow the orderly and timely construction of all stormwater management projects.

9. **Establish a dedicated and comprehensive funding source for planning, constructing, and maintaining the stormwater management program and implementing watershed plans.**

10. **Establish a method to evaluate the cost effectiveness of stormwater projects that consider social, environmental, and economic factors.**

Timely Construction of Stormwater Management Facilities. Funding limitations and the lack of timely construction of stormwater management facilities have created some difficulties in addressing environmental degradation throughout the County. As watersheds are developed, the degradation of streams is accelerated, creating the need for protection and increasing the need for funding. Although most of the County has been developed, there may be some opportunities to implement facilities prior to additional development in their drainage areas.

11. **Where practicable, ensure that planned stormwater management facilities are installed and functioning prior to development in upstream areas.**

Maintenance and Property Values. The design, function, maintenance and appearance of regional ponds have affected property values by increasing some and decreasing others. Property values can be affected by maintenance, the location, and aesthetics of regional ponds and other related storm drainage measures. Although stormwater management ponds cannot be totally self-maintaining, the integration of natural functions during design can reduce maintenance costs. Changes in policy would be needed to better support such design changes.

12. **Modify stormwater management design criteria so that stormwater management facilities will mimic natural systems, to the extent practicable, thereby reducing maintenance needs.**

13. **Use landscaping and ecological restoration techniques to design aesthetically pleasing and environmentally sound stormwater facilities that will enhance community property values.**

14. **Explore new opportunities to provide economic incentives to better protect and enhance streams and stream valleys.**

C - Policy

Updated Policies. Current stormwater management policies have evolved over the last 40 years primarily in response to site specific problems and regulatory mandates. Policies seldom are visionary and have not been written to allow for much flexibility to accommodate changes in technology. Stormwater management policies often have been developed in an ad hoc manner and are minimally coordinated. The establishment of the Stormwater Planning Division of DPWES was a step towards providing coordination of stormwater management. In 1989, following a study of how to manage stormwater in the developing portion of the County, the County adopted a policy to stress the application of regional ponds. This policy no longer seems appropriate.

15. **Replace the current County Regional Pond policy with a comprehensive stormwater management policy that provides for a broad range of practices.**

16. **Ensure that policies and regulations are performance-based for redevelopment as well as new development. Policies should allow and encourage the use of low impact development techniques (LIDs) on individual residential parcels as appropriate. Examples of policies being employed in other jurisdictions, such as Prince George's County, should be reviewed for strategies that could be adapted to Fairfax County. As stated in Recommendation #3, broader categories of innovative practices should be incorporated into County policies such that they become accepted practices and achieve timely plan approval.**

17. **Develop and implement a process for coordinating all activities that affect watershed management in the County. This would provide for collaboration among all agencies and others involved in activities and/or decisions that can affect watershed management. It would ensure that such activities and decisions are compatible with established watershed management policies and plans.**

18. **Revise the current policies and plan approval process to balance the integrity of the watershed management plans with competing interests such as land development, maintenance and tree preservation.**

Waivers of Stormwater Management Requirements in Context of Watershed Management Plans. Detention waiver requests are reviewed in accordance with the requirements of the PFM, with only a limited evaluation of the impact on the downstream watershed and some consideration of the Master Drainage Plan. Because the Master Drainage Plan was crafted in 1978, this approach does not achieve current watershed management goals. Current Regional Pond Program policy encourages granting waivers for sites that drain to unbuilt regional ponds.

19. **In the evaluation of stormwater control waiver requests, consider the existing and potential cumulative impacts to the entire affected stream valley. Develop better analytical tools to examine impacts beyond the site for which the waiver is considered and to better determine cumulative impacts to the ecosystem.**

20. **Upon completion of watershed management plans, grant stormwater control waivers only when they do not conflict with watershed goals as established in these plans.**

D - Hydrology and Design

Runoff Volume Control. Current regulations, ordinances and policies do not adequately address the runoff volume resulting from development. Consequently, due to a lack of volume control, many streambanks in the County are eroding excessively. The present PRM description of adequate outfall does not sufficiently protect streams from degradation.

21. **Modify ordinances and policies to control runoff volume.**

Peak Flow Management. Regional ponds are designed to control the ten and/or two year storms. They are not designed to control the smaller, more frequent storm events that cause significant degradation and stream erosion. An alternative approach is necessary to protect the ecological integrity of streams. The PFM allows the use of some hydrologic calculation methods for the prediction of peak flow, which do not provide for the adequate protection of downstream segments. The PFM does not provide for the use and evaluation of integrated low impact development designs (LIDs) on reducing stormwater flow.

22. **Require the use of hydrology calculations based on methodology that will be consistent with those used to develop the watershed plans. Hydrologic evaluations should provide for unique site situations that call for unique design and construction techniques.**

23. **Disallow the use of the Rational Method to evaluate flow impacts on streams. Newer more accurate and consistent methods similar to the NRCS (SCS) TR-55 method should be used.**

24. Revise the PFM to allow and encourage LID, Better Site Design techniques, and other innovative stormwater management practices.

25. Revise the PFM to require extended detention to control the one-year, 24 hour storm, separate and apart from the BMP design, as a pond design requirement for stream protection and adequate outfall purposes.

26. Revise the PFM dam standards for SWM ponds to provide greater flexibility in order to improve pond appearance and tree preservation (e.g., lower required dam height). Regional ponds should be designed as a system that optimizes environmental benefits, considering multiple objectives (e.g., flood control, stream protection, tree preservation, water quality, habitat preservation, etc.).

"Better Site Design" Approaches. The current process for implementing SWM steers projects toward the use of hard engineered solutions as opposed to more biologically oriented or Better Site Design ("softer") approaches. For example, current ordinances encourage the use of extended detention dry ponds for SWM purposes. This process does not encourage proven engineering approaches, such as reduced and disconnected impervious surfaces or rain gardens, which yield effective hydrologic and ecological results.

27. Revise the PFM to encourage the use of proven engineering practices that yield effective ecological results (i.e., reduced impervious surfaces, etc.) as well as achieve hydrologic control criteria.

28. Encourage pilot research projects to test innovative applications, and collaborate with others in ongoing research, which could improve all aspects of SWM facility design and help Fairfax County achieve its basic watershed management objectives of flood control, water quality protection, and erosion and sediment control. Allow these research projects to be conducted under various controlled scenarios so that their impacts can be evaluated in the field.

29. Consider changes in the maintenance policy to provide for alternative methods of performing maintenance on regional and other stormwater management facilities.

E - Land Use

Addressing Stormwater Management during Zoning and Watershed Planning Processes. Land use is continually changing the landscape in Fairfax County, not only in the western part of the County but also in the more urbanized/developed areas. As land use changes, hydrologic conditions and water quality also change. Presently, Stormwater Management considerations are not an integral part of the land use planning process. Detailed Stormwater Management design information is not available

during the zoning process. As a result, it is difficult to fully evaluate stormwater impacts and the effects of Stormwater Management facilities on site designs during the rezoning process.

30. Consider land use and transportation elements in conjunction with watershed management planning. Consider planned land use densities and areas of impervious surface in the development of watershed management plans. Consider land use plan changes as a possible mechanism to address watershed management planning goals.

31. Carefully evaluate the impacts on stormwater management systems, including streams, when making land use decisions.

32. During the zoning process, perform more detailed evaluations of impacts of stormwater management measures on site design (e.g., the footprints and appearances of stormwater management facilities), the impacts of impervious surface changes on streams, and relationships of zoning proposals to watershed planning. Submission requirements for zoning applications should be revised in order to allow for such evaluations.

33. Amend the County Code to allow for Better Site Design and other watershed protection techniques.

34. Consider various approaches for establishing stream valley buffers further upstream of Resource Protection Areas that will help mitigate the impacts of by-right development and redevelopment.

35. In the watershed management planning effort, consider establishing specific requirements within individual watersheds or sub-watersheds that protect and restore environmentally sensitive areas through enhanced levels of stormwater controls.

F - Parks and Recreation

Impact of Regional Ponds on Park Lands. The FCPA is the steward of many ecologically important lands within the County. Many regional ponds are planned on park property within these ecologically sensitive areas. Because of this situation, FCPA generally opposes the siting of stormwater regional ponds on these lands. Many stormwater quantity control waivers have been granted for sites upstream of ponds planned on park lands. As a result, park lands have been negatively impacted.

36. Ensure that the siting of regional ponds does not damage significant and sensitive parklands and is consistent with park goals.

37. Involve the FCPA as an active participant in the watershed management planning process. It is essential that the watershed management planning process include FCPA objectives and work toward mutual County and Park Authority goals for environmental protection.

G - Public Health and Safety

Inherent Health and Safety Risks. Natural and man-made ponds and other SWM facilities often have inherent health and safety risks. For example, the potential for drowning and injuries in wet ponds must be considered as well as the potential for increasing mosquito populations in poorly designed or inadequately maintained dry ponds. The goal of any stormwater management program is to diminish these risks as much as possible.

38. Encourage signage at all regional ponds indicating the depth of water and the potential for rising water conditions during rain events.

39. Encourage the design or retrofit of measures to promote natural barriers to access ponded areas and encourage ecological balance that includes natural predators to mosquitoes.

40. Enhance maintenance and inspection programs to address the potential health and safety issues, including mosquito breeding areas.

41. Establish an education campaign to inform the public about health and safety concerns associated with stormwater management facilities. Supplement the educational efforts currently being conducted as part of the watershed management planning process.

42. Consider health and safety in the decision process for determining the stormwater management techniques to be used at specific sites.

H - Aesthetics

Aesthetically Pleasing Design and Maintenance. Stormwater management facilities that mimic or integrate themselves into the natural landscape have high aesthetic value and can enhance the surrounding properties. Ideally, ponds would blend in with the character of the community such that they would not be noticed. Traditionally, Fairfax County has not required consideration of these elements as part of the design process.

43. Design stormwater management facilities in order to improve aesthetics by:

- **Designing ponds as natural areas that will require little or no maintenance**
- **Designing alternative measures that will eliminate concrete trickle ditches**
- **Providing more pleasing aesthetic designs for the risers so they do not look like concrete bunkers**
- **Using the services of a landscape architect to help plan, design, and evaluate stormwater management measures**
- **Incorporating into the design of wet ponds, measures such as natural buffers that discourage congregating waterfowl**
- **Revising the PFM to provide more flexibility in allowing alternatives and modifications to practices**

44. Encourage community stewardship for the aesthetic improvement of stormwater management facilities by instituting adopt-a-pond or similar programs.

45. Design parking lots with devices to intercept trash and keep it out of the storm drainage system.

46. Provide pet waste stations (complete with plastic bags) around the ponds, arrange for trash disposal, and enforce existing pet waste regulations.

47. Initiate an awards program for aesthetically pleasing stormwater management design and maintenance.

I - Construction Planning and Phasing

Retrofitting Developed Areas, Temporary Stormwater Management Controls, and Integrated Water Quality and Quantity Waivers. Much of the land in Fairfax County has already been developed, which precludes the installation of stormwater management facilities prior to initial development. Redevelopment changes SWM/BMP control needs. Most existing stormwater control facilities are not designed to properly control for maximum watershed development potential. In many cases this may artificially increase the size of the facility and may allow greater discharge rates from the facility.

48. Develop a decision matrix to evaluate alternatives to proposed regional ponds.

49. Design a program to retrofit stormwater management and water quality controls in areas that were developed prior to current stormwater regulations. This program could include reduced discharge rates in sub-watersheds to compensate for uncontrolled watershed areas.

50. Evaluate and update the County's impervious cover assumptions so that each SWM/BMP facility is designed for imperviousness associated with the maximum upstream development potential.

51. Revise the PFM to ensure that stormwater management systems are designed to control all drainage flowing into them.

52. Require temporary stormwater management as a condition of on-site detention waivers until regional stormwater ponds are installed.

53. Require temporary BMP controls until regional stormwater ponds are installed.

54. Establish conditions on Stormwater Management (detention) and BMP (water quality) waivers to ensure that measures are provided to offset, to the greatest extent practicable, the impacts of the waivers being granted.

55. Grant waivers dealing with stormwater controls and floodplain management only if they are in compliance with watershed management plans.

56. Change the County Code and PFM requirements that govern the granting of detention and BMP (water quantity and water quality) waivers so that they are integrated and considered together within the framework of watershed management plans.

J - Public Participation, Outreach and Support

Public Education, Participation, and Support. Public engagement is needed for stormwater programs to be successful. It is important for the community to have a sense of ownership. Citizen-initiated concerns often culminate in fully-funded and successful programs.

57. Incorporate public participation early in the process making affected citizens part of the design/review/implementation team.

58. Design and establish a strong public support program within the watershed planning and implementation process.

59. Increase community awareness of the need to solve stormwater problems and to have a dedicated source of funds to support stormwater management programs.

60. Institute and support a community incentives/awards program for maintaining stormwater management systems.

61. Support and/or initiate local watershed management groups in each major watershed and in each of their major tributaries. Partner with these groups in the design, review, implementation, and maintenance of stormwater management systems.

V - Unified Position on Regional Ponds and Other Watershed Management Tools

After much deliberation, research, consultation with the public, and consideration, the Subcommittee identified 61 recommendations (included in the previous section) to improve Fairfax County's stormwater management program and to clarify the role of regional ponds in that program. The Subcommittee recommends the implementation of all 61 recommendations. Upon the Board of Supervisors' acceptance of this report, DPWES should coordinate development of an implementation plan for these recommendations, including a time line and assignments. In addition the Board of Supervisors should authorize the consideration of amendments to The Comprehensive Plan that would ensure that the Plan is consistent with any recommendations endorsed by the Board of Supervisors.

The Subcommittee highlights the following key elements of the recommendations:

- Revise the current County policy regarding regional ponds to reflect these recommendations. In particular, designate regional ponds as just one of many stormwater management tools.

- Develop recommendations for stormwater management practices as part of the watershed planning process. Until that time, use an interim decision matrix (Appendix P) as the guidance for determining whether regional ponds are appropriate on a case-by-case basis. A pilot project should be initiated to validate the interim decision matrix. In general, regional ponds should not be considered a preferred alternative. Regional ponds should just be one of many tools considered for stormwater management practices.

- Develop a second matrix for use in preparing watershed management plans. This matrix should provide options when considering and evaluating stormwater management alternatives.

- Carefully evaluate the impacts on stormwater management systems when making land use decisions.

- In addition, the Subcommittee recommends the following specific items:

    - In watersheds where regional facilities currently are planned, require temporary on-site facilities until regional ponds or equivalent stormwater practices are implemented.

    - Establish conditions on Stormwater Management (detention) and BMP (water quality) waivers to ensure that measures are provided to offset, to the greatest extent practicable, the impacts of the waivers being granted. Ensure that waivers dealing with stormwater controls and floodplain

management are granted only in concurrence with watershed management plans.

- Use alternatives to regional ponds where consistent with the watershed management plans. When regional ponds are warranted, use techniques to reduce the impacts of the pond.

- Allocate adequate resources to accomplish these recommendations.

GLOSSARY

1-year storm: A storm event with the 100% probability of happening in any given year.

2-year storm: A storm event with 50% probability of happening in any given year.

10-year storm: A storm event with 10% probability of happening in any given year.

A

Adequate outfall: The term “outfall” describes receiving pipes, channels, or streams that convey stormwater discharges generated by development sites. Under current County requirements, an outfall is considered adequate if it conveys stormwater discharges without: exceeding its capacity, flooding structures, or creating severe or adverse erosion impacts. The term “adequate outfall”, as it relates to stream channels, was used to describe a channel with existing bed and banks capable of performing the functions listed above.

B

BMP: Best Management Practices: A practice, or combination of practices that is determined to be the most effective practicable means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals. Structural BMP refers to facilities designed for the purpose of reducing the pollutant load in stormwater runoff, and usually require earth movement for installation. Nonstructural BMP refers to land use or development practices that are determined to be effective in minimizing the impact on receiving stream systems, such as preservation of open space and stream buffers, disconnection of impervious surfaces, etc., and do not require earth movement to implement.

Best Management Practices: See BMP

Better Site Design: Design techniques that employ a variety of methods to reduce the negative impact of residential and commercial developments on watersheds and aquatic resources through decrease in impervious cover, increase in natural land set aside for conservation and use of pervious areas for more effective stormwater treatment (Article 45).

Bioretention: Also known as Rain garden, a BMP practice to manage and treat stormwater runoff using a conditioned planting soil bed and planting materials to filter stormwater runoff. Runoff is treated by a combination of physical (filtering, adsorption, and volatilization) and biological processes. The ideal facility includes several components, including a pretreatment filter strip (grassed channel) inlet area, a ponding area, a rain garden planting area, a soil zone, an underdrain system, and an overflow system.

Buffer area: A vegetated zone adjacent to a stream, wetland, or shoreline where development is restricted or controlled to minimize the effects of development.

Build-out: The development level of the County if fully developed to the maximum density of The Comprehensive Plan.

By-right development: Development that does not require special approval by the Board of Supervisors, Planning Commission, Board of Zoning Appeals, or Zoning Administrator (e.g., no rezoning, special exception, special permit, or variance is required). Such development must meet all applicable County Code requirements (including conformance with Zoning Ordinance and Public Facilities Manual requirements) but is not required to comply with Comprehensive Plan policies.

C

CBPO: Chesapeake Bay Preservation Ordinance. Chapter 118 of The Code of The County of Fairfax, first adopted March 22, 1993, effective July 1, 1993.

CIP: Capital Improvement Program.

Clean Water Act: A law enacted by the United States Congress in 1972 and enforced by the Environmental Protection Agency on the national level. The Clean Water Act established three main goals: 'zero discharge' or the elimination of polluting discharges to the nation's waters by 1985; 'fishable and swimmable waters' or the restoration and protection of water quality and wildlife habitat; and 'no toxins in toxic amounts' or the prohibition of the discharge of toxic pollutants in amounts that are toxic to the environment or life.

Conservation Easement: A nonstructural BMP which is a legal mechanism whereby a landowner or homeowners association retains ownership of the land, but grants some rights to a 'holder' that is defined as a charitable organization (usually the County).

Constructed stormwater wetlands: Area intentionally designed and created to emulate the water quality improvement function of wetlands for the primary purpose of improving the stormwater quality.

Contributing drainage area: An area of land that contributes stormwater runoff to a designated location.

Cumulative impact analysis: When the effect of each development site is analyzed on a watershed or sub-watershed level to determine the total or cumulative effects of all developments on the receiving stream system at any location along the stream.

D

Density: The number of persons or dwelling units per acre. Development intensity.

Detention: Holding stormwater for the purpose of reducing the discharge release rate.

Detention pond: A stormwater management facility that temporarily impounds stormwater runoff and discharges it through a hydraulic outlet structure to a downstream conveyance system. A detention pond is normally dry between rainfall events. Also known as dry pond.

Detention waiver: In Fairfax County, relief from providing on-site stormwater quantity control for increasing runoff rates from the construction of impervious area or development of land. Normal requirements are to reduce discharge rates for each of the 2-year and 10-year storm events to the predevelopment discharge rate.

DPWES: Department of Public Works and Environmental Services.

Drainage Area: See Watershed.

Dry pond or dry detention pond: A stormwater management facility designed to control the peak discharge rate through temporary storage of stormwater runoff, and discharges the runoff through an outlet structure to a downstream conveyance system. Stays dry during non-rainfall periods.

E

Ecosystems: All of the component organisms of a community and their environment that, together, form an interacting system.

EQC: Environmental Quality Corridor. In Fairfax County, an open space system designed to link and preserve natural resource areas and provide passive recreation. The system includes stream valleys, wildlife habitats and wetlands.

Extended detention: Temporary impoundment of stormwater runoff, over a specific period of time inside a dry stormwater pond, prior to discharge into a downstream conveyance system for the purpose of water quality enhancement and stream channel erosion control.

F

FCPA: Fairfax County Park Authority.

Floodplain: Those land areas in and adjacent to streams and watercourses subject to continuous or periodic inundation from flood events. Fairfax County regulates activities in 100-year floodplains that have a contributing drainage area of 70 acres or more. Flood events with a one (1) percent chance of occurrence in any given year (i.e., the 100-year flood frequency event) would inundate the 100-year floodplain.

G

GIS: Geographic Information System. A method of overlaying spatial land and land use data of different kinds. The data are referenced to a set of geographical coordinates

and encoded in a computer software system. GIS is used by many localities to map utilities and sewer lines and to delineate zoning areas.

H

Hard engineered solutions: In-stream restoration practices that use materials such as concrete or rock to stabilize stream bank and channel cross-section.

Hydraulics: Control, treatment, movement and quantification of water in open channels, naturally or artificially occurring bodies of water, or of water otherwise lying on or beneath earth surface

Hydrology: The science addressing the properties, distribution, and circulation of water across the landscape through the ground and in the atmosphere.

I

Impervious surface: A surface composed of any material, which prevents the infiltration and passage of water through it. This may apply to roads, streets, sidewalks, parking lots, rooftops, and sidewalks. Does not include the surface area of a swimming pool.

Infiltration: The downward movement of water from the land surface into the soil.

In-stream stormwater management facilities: Stormwater control facilities, such as ponds, constructed wetlands, etc. that are located within the stream where stream flows directly into the facility.

L

Land use density: For residential development, the number of dwelling units per acre. For nonresidential development, the floor area ratio (the gross floor area of all buildings on a lot divided by the area of that lot).

Low Impact Development (LID): The integration of site ecological and environmental goal and requirements into the all phases of urban planning and design from individual residential lot level to the entire watershed.

M

Major floodplain: In Fairfax County, a floodplain with a drainage area of 360 acres or more.

Master Drainage Plan: A comprehensive systematic analysis of the existing stormwater problems and anticipated problems due to projected future development. The Master Drainage Plan for Fairfax County was conducted during the late 1970's and resulted in recommendations for drainage way improvements which are included in an Immediate Action Plan and Future Basin Plan for each of the 30 watersheds in the County.

Minor floodplain: In Fairfax County, a floodplain with a drainage area of between 70 acres and 360 acres.

N

Non-point source pollution: Refers to contaminants such as sediments, nutrients, hydrocarbons, heavy metals, and toxics, which are transported by stormwater runoff. The term is used to distinguish such diffuse overland runoff from point source pollution such as that that flows from a pipe.

Nonstructural BMP: See BMP.

NRCS: Natural Resources Conservation Service, formerly known as Soil Conservation Service (SCS). An agency of the United States Department of Agriculture.

Nutrient loading: Nitrogen, phosphorus and other nutrients carried by runoff water over land, deposited in streams and eventually carried to a lake, pond or other major waterbody.

O

On-site detention: Stormwater detention ponds that generally serve a drainage area less than 100 acres.

Open space: Land set aside for public or private use within a development that will not be disturbed or built on.

P

Peak Discharge: Also called peak flow rate, is the maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event (e.g. a 2-year storm).

Perennial stream: A body of water flowing in a natural or man-made channel year-round, except during periods of drought. The term “water body with perennial flow” includes perennial streams, estuaries, and tidal embayments. Lakes and ponds that form the source of a perennial stream, or through which the perennial stream flows, are a part of the perennial stream. Generally, the water table is located above the streambed for most of the year and groundwater is the primary source for stream flow. In the absence of pollution or other manmade disturbances, a perennial stream is capable of supporting aquatic life**.**

PFM: Public Facilities Manual. The PFM sets forth the guidelines, which govern the design of all public facilities that must be constructed to serve new developments in Fairfax County.

Pro Rata Share Program: A fee collection program, which assesses land owners/ developers as impervious areas are created. These fees provide a ‘proportionate share’ of the cost of providing storm drainage and stormwater management

improvements made necessary, or required at least in part, by the development of land. Each major watershed has a separate fee rate, which is based on the identified and qualifying projects within the watershed, along with the projected and existing land build-out levels within the watershed.

Pro Rata Share Drainage Construction Fund: The Fairfax County fund account used for storm drainage and stormwater capital improvement project expenditures. These storm drainage and stormwater projects must be a component of Fairfax County's Pro Rata Share Program. The source of the funds is from land owners/developers and collected as impervious areas are constructed within the County.

Proffer: In Fairfax County, A development plan or condition, which, when offered voluntarily by an owner and accepted by the Board of Supervisors, becomes a legally binding part of the regulations of the zoning district pertaining to the property in question. Proffers, or proffered conditions, must be considered by the Planning Commission and submitted by an owner in writing prior to the Board of Supervisors public hearing on a rezoning application, and therefore may be modified only by an application and hearing process similar to that required of a rezoning application.

Public Facilities Manual: See PFM.

Public Works Construction Fund: A Fairfax County fund account used for capital improvement project, including storm drainage and stormwater management, expenditures.

R

Rain Garden: Also known as bioretention, is a BMP used to manage and treat stormwater runoff. Its components are a conditioned planting soil bed with native or indigenous planting materials that filter stormwater runoff. Runoff is treated by a combination of physical (filtering, adsorption, and volatilization) and biological processes. The ideal facility includes several components, including a pretreatment filter strip (grassed channel) inlet area, a ponding area, a rain garden planting area, a soil zone, an underdrain system, and an overflow system

Rational Method: The most commonly used method of determining peak runoff flow rates from small watersheds (up to 20 acres) based on average percent imperviousness of the site, mean rainfall intensity, and drainage area.

Recharge: Replenishment of the groundwater aquifers by infiltration and transmission of water through permeable soil layers.

Redevelopment: Development activity generally characterized by clearance of existing structures and new construction. The new development may be the same type of land use, or new type, but is usually at a higher level of intensity or density than that it replaces.

Regional Pond Program: A network of regional detention/retention (dry/wet) ponds which are intended to provide water quality and erosion/flood control benefits for development of land in portions of seven of Fairfax County's watersheds. A pilot program approved by the Board of Supervisors during 1989. This program of regional ponds takes the place of providing several on-site stormwater management facilities, by providing fewer larger facilities rather than several smaller facilities.

Regional pond: Regional ponds are stormwater management ponds that are part of the County's Regional Pond Program. Regional ponds generally control a drainage area of 100 acres or more to meet stormwater quantity and stormwater quality criteria for its entire watershed (beyond that of the development in which it lies). Regional ponds may or may not have a permanent water surface elevation.

Resource Management Area (RMA): That component of the Chesapeake Bay Preservation Area comprised of lands that, if improperly used or developed, have a potential for causing significant water quality degradation or for diminishing the functional value of the Resource Protection Area.

Resource Protection Area (RPA): That component of a Chesapeake Bay Preservation Area comprised of lands at or near the shoreline or water's edge that have an intrinsic water quality value due to the ecological and biological processes they perform or are sensitive to impacts which may result in significant degradation of the quality of state waters. In their natural condition, these lands provide for the removal, reduction, or assimilation of sediments, nutrients, and potentially harmful or toxic substances from runoff entering the Bay and its tributaries, and minimize the adverse effects of human activities on state waters and aquatic resources.

Retention pond: See wet pond.

Riser: A vertical structure which extends from the bottom of an impoundment facility and houses the control devices (weirs/orifices) to achieve the desire rates discharge for specific designs.

S

SCS: Soil Conservation Service, presently known as Natural Resources Conservation Service (NRCS). An agency of the United States Department of Agriculture.

Soft engineering solution: Similar to soil bioengineering techniques.

Soil bioengineering techniques: Non-structural practices that use live and dead plant materials, in combination with natural and synthetic support materials, for slope and stream bank stabilization, erosion reduction, and vegetative establishment.

Storm Drainage Bond Construction Fund: A Fairfax County fund account used for specific storm drainage or stormwater management capital improvement projects. The

source of funds is derived from the sale of bonds to obtain long term financing as approved by County voters through bond referenda.

Stormwater runoff: That portion of precipitation that is discharged across the land surface or through conveyances to one or more waterways.

Stream valley buffer: A vegetative strip of woody or herbaceous plants of the appropriate width to provide water quality protection for the stream and adjacent land use.

Stream valley: An aggregation of features produced by the physical action of flowing water which includes intermittent or perennial stream, its associated floodplain and adjacent slopes.

Structural BMP: See BMP.

STW: Stormwater.

Subwatershed: A defined land area within a watershed drained by a river, stream or drainageway, or system of connecting rivers, streams, or drainageways such that all surface water within the area flows through a specific point.

T

Thermal impact: The impact of increase in water temperature on the chemical and biological properties of streams, reservoirs.

TR-55: Technical Report 55, Urban Hydrology for Small Watersheds. NRCS (formerly SCS) watershed hydrology computation model that is used to calculate runoff volume, peak runoff discharge and provide a simplified routing for storm events through stream valley and/or ponds.

Tributary stream: Any perennial stream that is so depicted on the most recent U.S. Geological Survey 7 ½ minute topographic quadrangle map (scale 1:24,000).

Trickle ditch: A small paved concrete channel built inside dry detention ponds that connects the pond inlet to the outlet device (riser). It is designed to convey low flow runoff or base flow, through the facility, without detention.

V

Vegetative buffer: Woody or herbaceous plant material that provide protection, screening or wildlife habitat/corridor.

W

Waiver: In Fairfax County, relief from compliance with a policy or ordinance provision. Usually approved through an administrative process.

Water quality control waiver: In Fairfax County, relief from providing normal water quality control resulting from land disturbance activity. Normal requirements are for new development to provide BMPs, which reduce the projected phosphorus runoff pollution load by no less than 40% (or 50% in the Occoquan Watershed).

Water table: Upper surface of the free groundwater in a zone of saturation, indicates the upper most extent of groundwater.

Watershed Plan: A holistic approach to develop a consistent framework for providing an assessment of needs, encouraging public involvement and prioritizing the solutions for each watershed for protection and restoration of ecological systems and other natural resources within the watershed.

Watershed: The land area that contributes runoff to a given point along a stream, wetland or body of water. A watershed might consist of a number of sub-watersheds.

Wet pond: Also known as retention ponds or basins are man made stormwater facility that include a permanent pool of water much like a lake or natural pond. The wet pond is designed to hold a permanent pool above which stormwater runoff is stored and released at a controlled rate into a downstream conveyance system.

Wetlands: Any land characterized by wetness for a portion of the growing season. Wetlands are generally delineated on the basis of physical characteristics such as soil properties indicative of wetness, the presence of vegetation with unusually strong affinity for water, and the presence or evidence of surface wetness. Wetland environments provide water quality improvement benefits and, in most cases, are ecologically valuable.

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